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UNCLASSIFIED
RESTRICTED
ATSC MANUAL No. 25-3

INDUSTRIAL HYGIENE MANUAL

SUPPLEMENT I

Pictures of Processes

Processes

Toxic Agents

Suggested Control Measures

Health Hazards



| | |
|------------------------|----------------|
| CLASSIFICATION CHANGED | |
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| Frank B. Rogers | |

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HEADQUARTERS, AIR TECHNICAL SERVICE COMMAND

Wright Field, Dayton, Ohio

15 April 1945

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HEADQUARTERS

ATSC REGULATION) AIR TECHNICAL SERVICE COMMAND
NO. 25-3) WRIGHT FIELD JANUARY 1945

MEDICAL

Industrial Hygiene Manual, Supplement No. 1

1. Purpose: The purpose of this Regulation is to establish the Industrial Hygiene Manual, Supplement No. 1, No. 25-3 as an official guide and training aid.

2. Scope: This Manual will apply to Medical Corps officers, Sanitary Corps officers, and enlisted men engaged in the control of occupational diseases, and will be used as a training aid for all Industrial Hygiene activities and tactical units within the ATSC.

3. Contents: The contents of the Manual, Supplement No. 1, describe toxic agents, suggested control measures and health hazards, and includes pictures of processes.

4. Supply: The office of the Surgeon, Hq. ATSC will make distribution of the Manual and be responsible for distribution of revisions as necessary.

By Command of Lieutenant General KNUDSEN:

T. A. SIMS

Colonel, Air Corps

OFFICIAL:

Chief of Administration

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Adjutant General

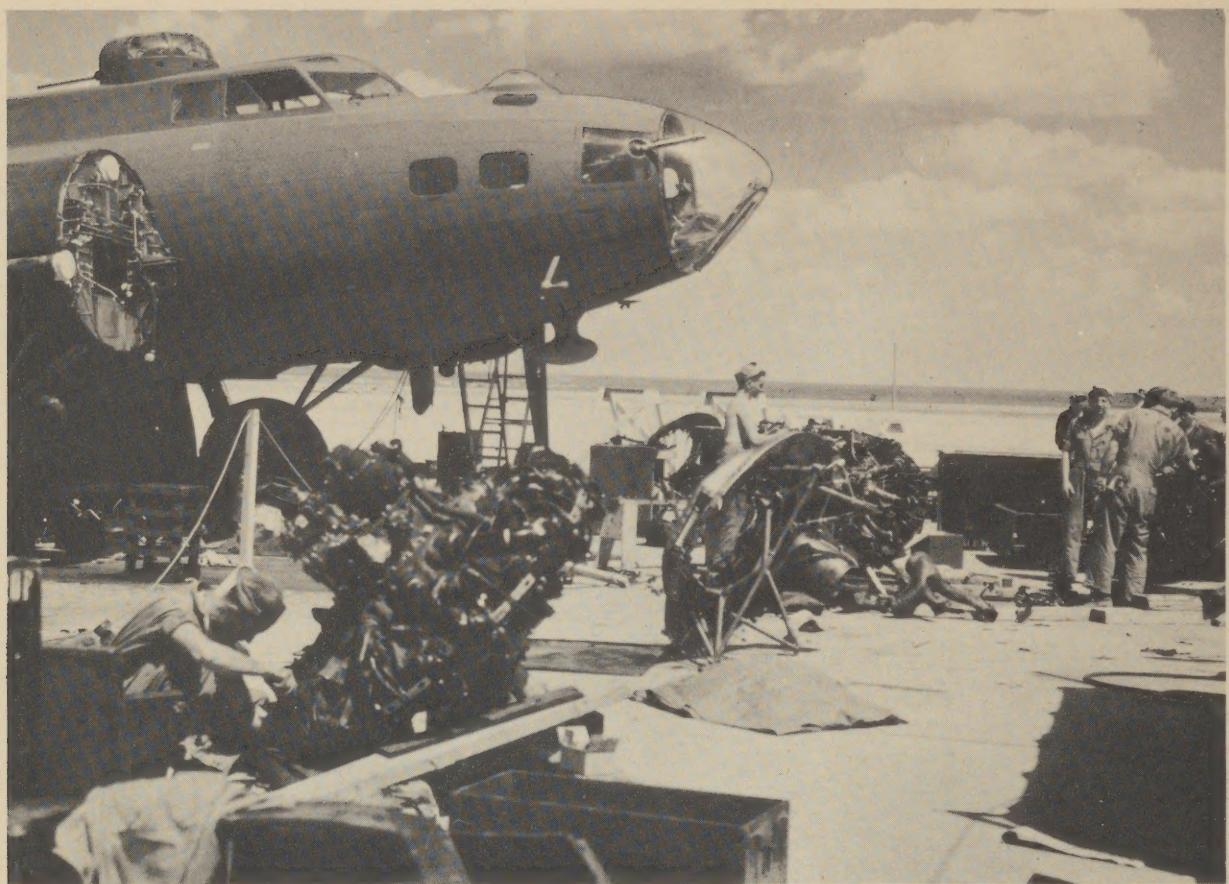
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FOREWORD

This supplement was compiled from information obtained from air depots and does not represent every operation in detail. It is intended to point out operations which offer potential health hazards and hazards known to exist under ordinary conditions. Ways and means of control of these conditions are suggested. Health hazards are enumerated for each process.

SECTION I AERO REPAIR

PROCESS.—Airplanes are completely overhauled and repaired including disassembly, cleaning, repair, reassembly, and complete change in type of aircraft.

TOXIC AGENTS

1. Carbon tetrachloride.
2. Solvent dry cleaning (petroleum distillate).
3. Gasoline.
4. Small quantities other toxic agents such as benzol, phosgene, toluene, acetone, amyl acetate, lead, ethyl alcohol, butyl alcohol, ethyl acetate, butyl acetate, petroleum naphtha, turpentine, carbon monoxide, caustic cleaners, oils, greases.

SUGGESTED CONTROL MEASURES

1. General exhaust or good natural ventilation.
2. Local exhaust ventilation for cleaning inside of planes.
3. Protective hand creams.
4. Strict personal hygiene.
5. Good housekeeping.
6. Covered solvent containers.
7. Isolation of any dope and paint operations.

HEALTH HAZARDS

Dermatitis may result from carbon tetrachloride, petroleum distillate (gasoline, petroleum naphtha), benzol, toluene, acetone, amyl acetate, lead, ethyl alcohol, butyl alcohol, ethyl acetate, butyl acetate, turpentine, caustic cleaner, oils, and greases.

1. PHOSGENE.—Very poisonous gas which affects primarily the respiratory system, causing a pulmonary edema.
2. CARBON TETRACHLORIDE.—If in sufficient concentration may cause an acute narcosis. Most common effect is chronic poisoning which injures permanently the kidneys and liver.
3. SOLVENT DRY CLEANING (petroleum distillate).—Gasoline, petroleum naphtha, may produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms.
4. BENZENE (benzol).—Is a very toxic material and usually presents a picture of aplastic anemia. This type of clinical picture is seen after prolonged exposure. The acute type of poisoning produces inebriation.
5. ACETONE.—There are no cases of poisoning reported in man. Experimentally on animals, it has an acute narcotic effect.
6. ACETATE (amyl, butyl, and ethyl).—Slight possibility of causing irritation of eyes and respiratory passages and mildly anesthetic. There are no fatal poisoning cases reported in man.
7. ALCOHOL (butyl and ethyl).—May produce blood changes with renal and hepatic degeneration if inhaled over a long period of time.

8. TURPENTINE.—Inhalation of heavy fumes causes symptoms of a mild anesthetic poison. It is excreted by the kidneys and nephritis is not an uncommon result of long exposure to turpentine fumes.
9. CAUSTIC CLEANER.—May produce dermatitis and conjunctivitis along with caustic effect.
10. OILS AND GREASES.—Usual damage is an oil dermatitis which can be controlled by proper corrective measures.
11. CARBON MONOXIDE.—If in sufficient concentration will produce anoxemia causing unconsciousness and death.

SECTION II

ASSEMBLED ENGINE CLEANING

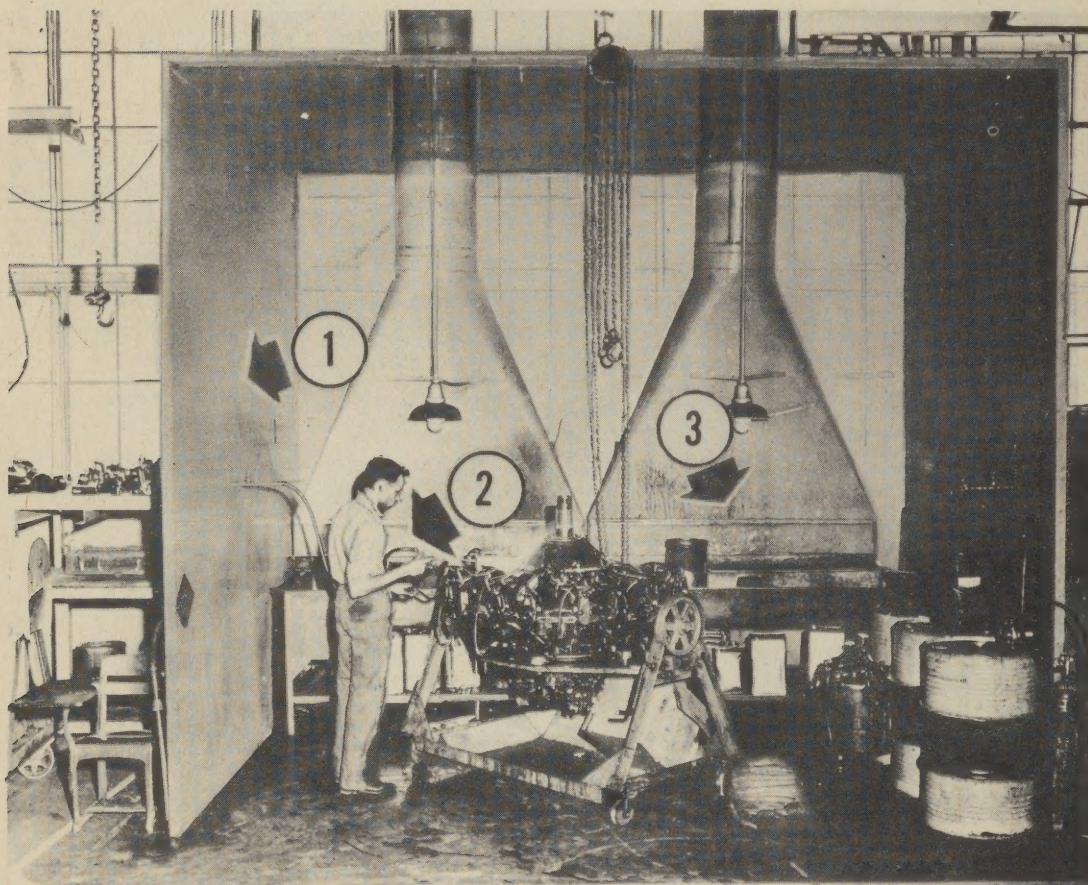
PROCESS.—Assembled engines are cleaned and sprayed with rust-protective material.

TOXIC AGENTS

1. Rust-preventive (probably vegetable oil butyl alcohol, 3 percent tertiary phenolic amine).
2. Solvent dry cleaning (petroleum distillate).
3. Kerosene.

SUGGESTED CONTROL MEASURES

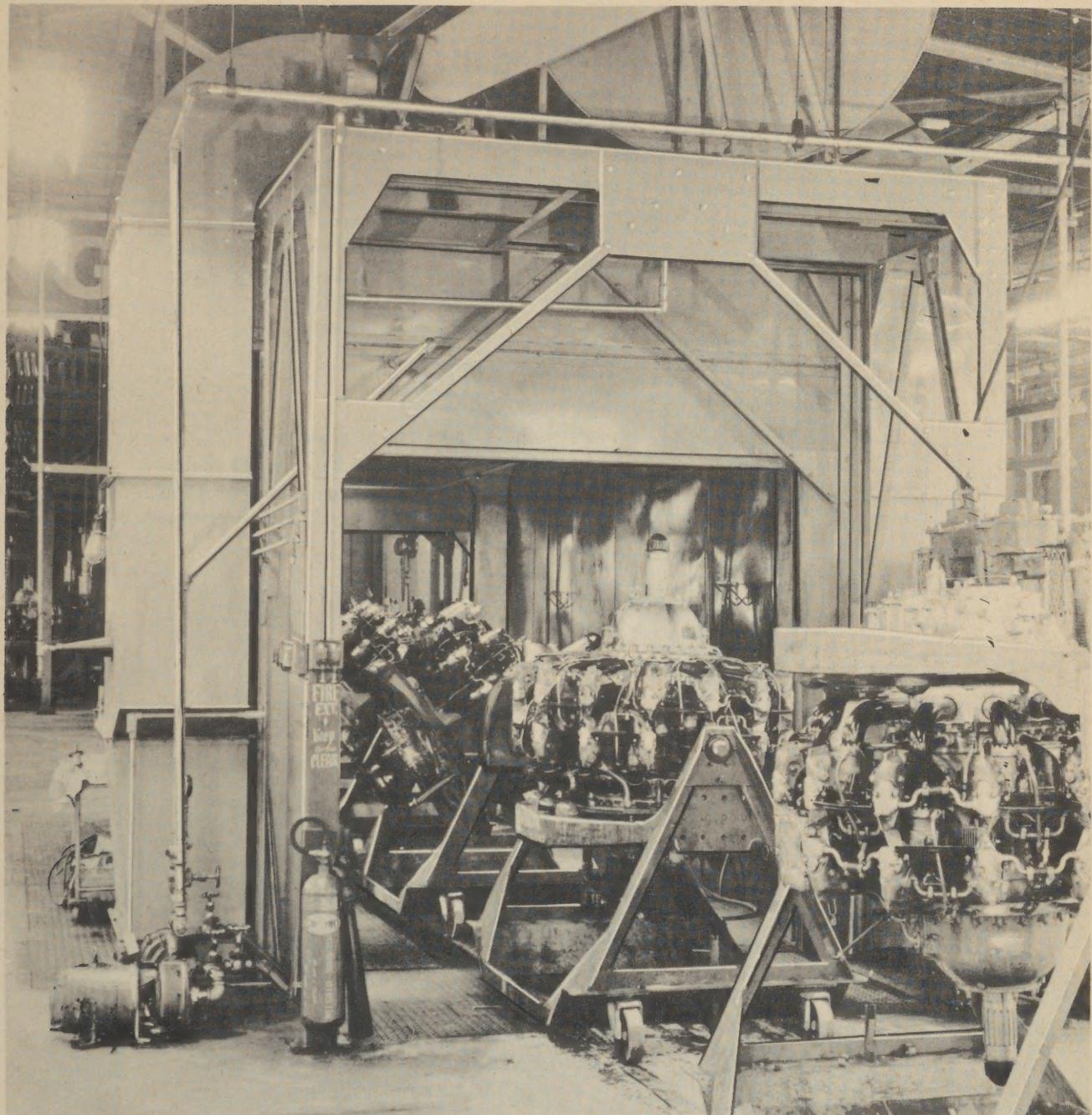
1. Exhaust ventilation (booth).
2. Protective creams and ointments.
3. Protective clothing such as gloves, aprons, and boots.
4. Strict personal hygiene.



1. Booth Enclosure.

2. Spray cleaning.

3. Improper ventilation.



Booth enclosure provided with an air curtain at each end to prevent escape of vapors to room.

HEALTH HAZARDS

Dermatitis may result from rust-preventive (probably phenolic amine), petroleum distillate, and kerosene.

1. **BUTYL ALCOHOL.**—May produce an acute inebriation but no fatal cases of industrial poisoning published.
2. **SOLVENT DRY CLEANING.**—May produce an acute anesthetic action or produce a chronic type of poisoning usually associated with nervous symptoms. Petroleum distillate may also contain benzene.
3. **KEROSENE.**—Is a petroleum distillate.

SECTION III
BATTERY

PROCESS.—Batteries receive minor repairs and are recharged.

TOXIC AGENTS

1. Lead.
2. Sulphuric acid.
3. Sulphur dioxide.

SUGGESTED CONTROL MEASURES

1. Local exhaust ventilation (hood type).
2. Rubber gloves, aprons, and face shields for operators.
3. Isolation of process.

HEALTH HAZARDS

Dermatitis may be caused by lead and sulphuric acid.

1. LEAD.—May produce any of the symptoms and signs of plumbism.
2. SULPHURIC ACID.—Chief danger is in spillage or breakage of containers.
3. SULPHUR DIOXIDE.—Produces an acute irritation of upper respiratory tract. Prolonged exposure to small amount may cause dyspnea, fatigue, and sluggishness.

SECTION IV
BLACKSMITH

PROCESS.—Tools and parts are heated in a forge and formed.

TOXIC AGENTS

1. Carbon monoxide.
2. Sulphur gases.
3. Excessive heat.

SUGGESTED CONTROL MEASURES

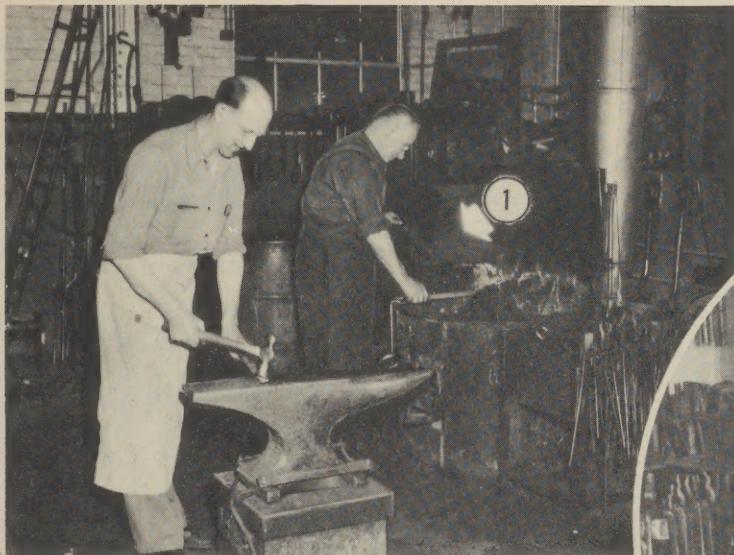
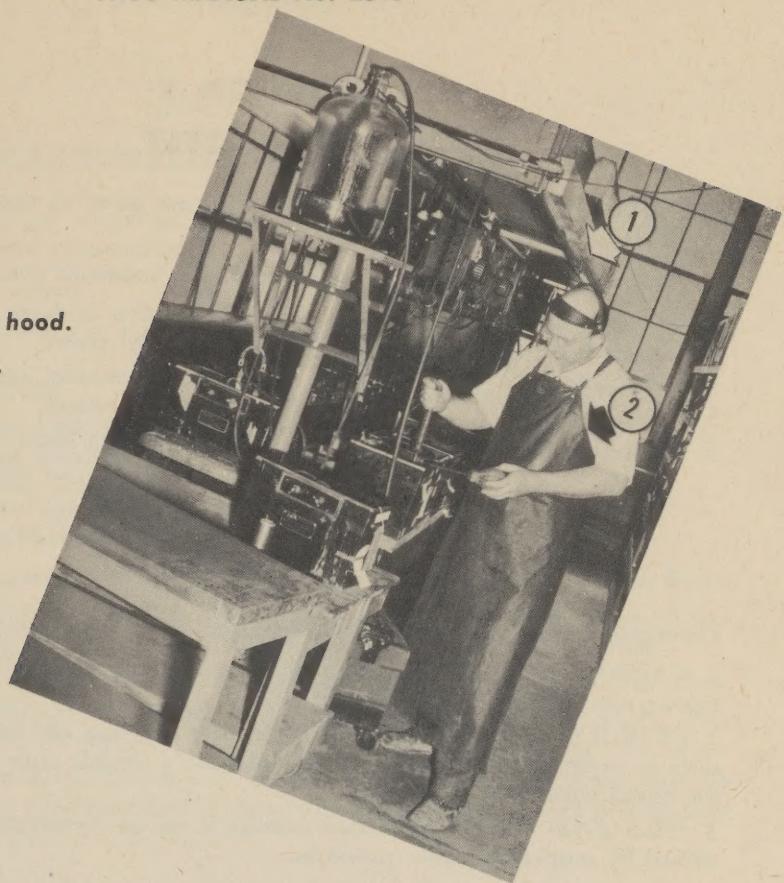
1. Local exhaust or good natural ventilation for forge.
2. Isolation of process.
3. General exhaust ventilation.
4. Good housekeeping.

HEALTH HAZARDS

Dermatitis may be caused by sulphur gases.

1. CARBON MONOXIDE.—If in sufficient concentration, will produce anoxemia causing loss of consciousness and death.
2. SULPHUR GASES.—Most important is sulphur dioxide, which produces an acute irritation of upper respiratory tract. Prolonged exposure to small amount may cause dyspnea, fatigue, and sluggishness.
3. EXCESSIVE HEAT.—May produce heat exhaustion with loss of body fluids and chlorides.

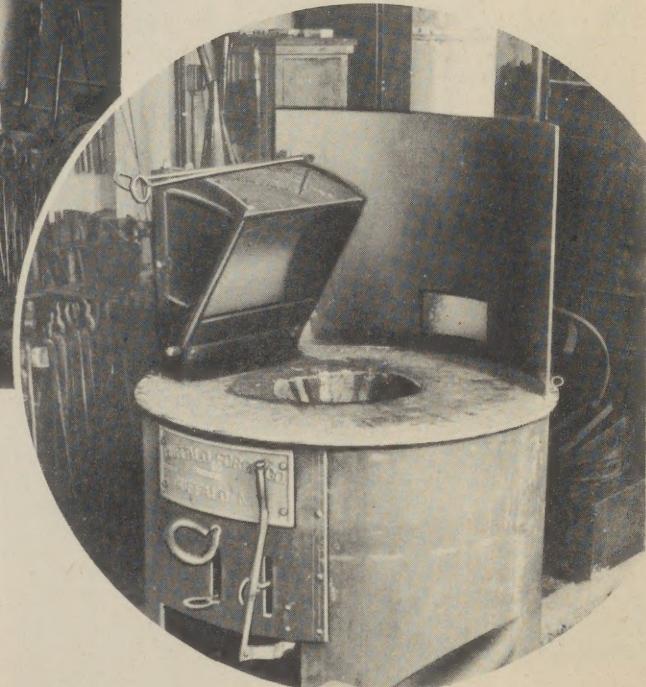
1. Exhaust ventilated hood.
2. Protective clothing.



An example of good housekeeping.

1. Local exhaust ventilation.

Local exhaust hood over forge.



SECTION V
BLOCK TEST

PROCESS.—New motors and repaired motors are given an operating test, cleaned, prepared for storage and shipping.

TOXIC AGENTS

1. Carbon monoxide.
2. Solvent dry cleaning (petroleum distillate).
3. Noise.
4. Kerosene, oils, greases.

SUGGESTED CONTROL MEASURES

1. Positive pressure ventilation of control room.
2. Local exhaust ventilation on oil return system.
3. Protective hand creams.
4. Protective ear plugs.
5. Proper design and location of block test buildings.

HEALTH HAZARDS

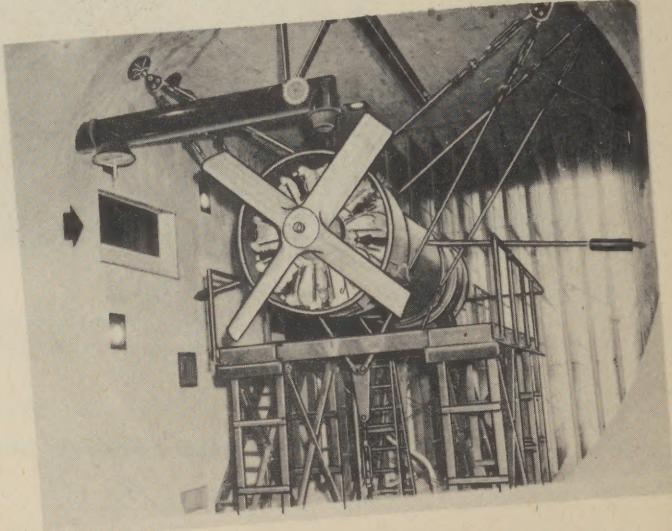
Dermatitis may be caused by solvent dry cleaning, kerosene, oils, and greases.

1. CARBON MONOXIDE.—If in sufficient concentration, will produce anoxemia, causing unconsciousness and death.
2. PETROLEUM DISTILLATES (solvent dry cleaning and kerosene).—May produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms.
3. OILS AND GREASES.—Usual damage is an oil dermatitis which can be controlled by proper corrective measures.



Operator's window.

Outlet for positive pressure ventilation.



SECTION VI

CARBURETOR AND IGNITION

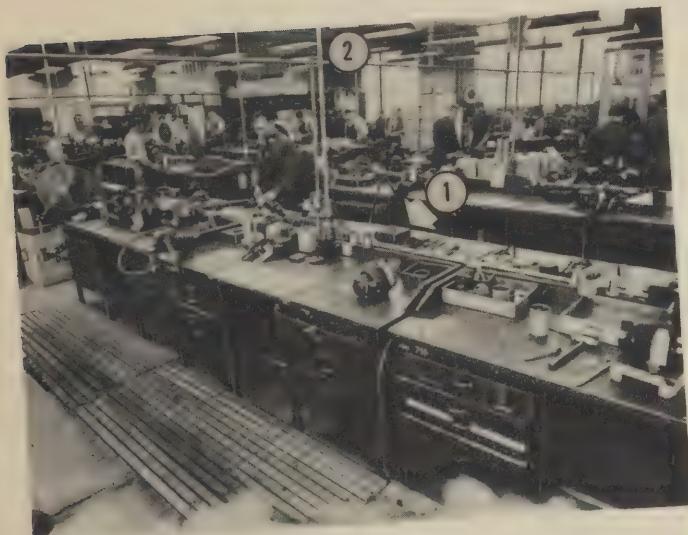
PROCESS.—Carburetors, magnetos, generators, and ignition parts are dismantled, cleaned, repaired, and reassembled.

| TOXIC AGENTS | SUGGESTED CONTROL MEASURES |
|---|--|
| 1. Solvent dry cleaning (petroleum distillate). | 1. General ventilation (exhaust or supplied air type). |
| 2. Carbon tetrachloride. | 2. Covered solvent containers. |
| 3. Small amounts of lead, decomposition products of commercial fluxes, hydrochloric acid. | 3. Protective hand creams. |

HEALTH HAZARDS

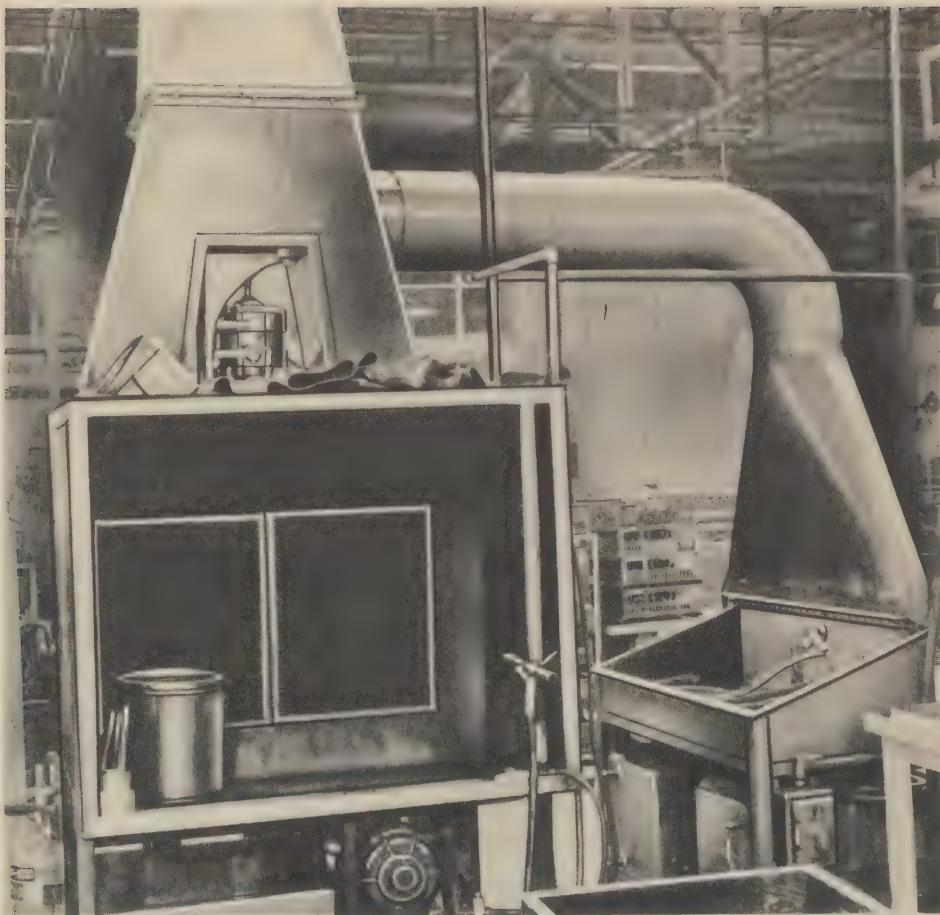
Dermatitis may be caused by solvent dry cleaning, lead, hydrochloric acid, and fluxes.

1. SOLVENT DRY CLEANING.—May produce an acute anesthetic action or produce a chronic type of poisoning usually associated with nervous symptoms.
2. LEAD.—May produce any of the characteristic signs and symptoms of plumbism.
3. HYDROCHLORIC ACID.—Usual danger is from spillage in open flame. Possibility of production of phosgene, which may produce edema of lungs and death.
4. CARBON TETRACHLORIDE.—If in sufficient concentration, may cause an acute narcosis. Most common effect is chronic poisoning which injures permanently the kidneys and liver.



*General exhaust ventilation
at a carburetor test stand
in an overseas installation.*





**Exhaust ventilated cleaning bench
and exhaust ventilated cleaning booth.**

SECTION VII

ELECTROPLATING

PROCESS.—Parts and fittings suspended in a chemical bath are electroplated by means of electric hydrolysis.

TOXIC AGENTS

1. Sodium cyanide.
2. Cadmium oxide.
3. Oxides of nitrogen.
4. Hydrofluoric acid.
5. Other chemicals which may be used are lead carbonate, copper sulphate, nickel sulphate, nickel chloride, phosphoric acid, acetic acid, caustic soda, chromic acid.

SUGGESTED CONTROL MEASURES

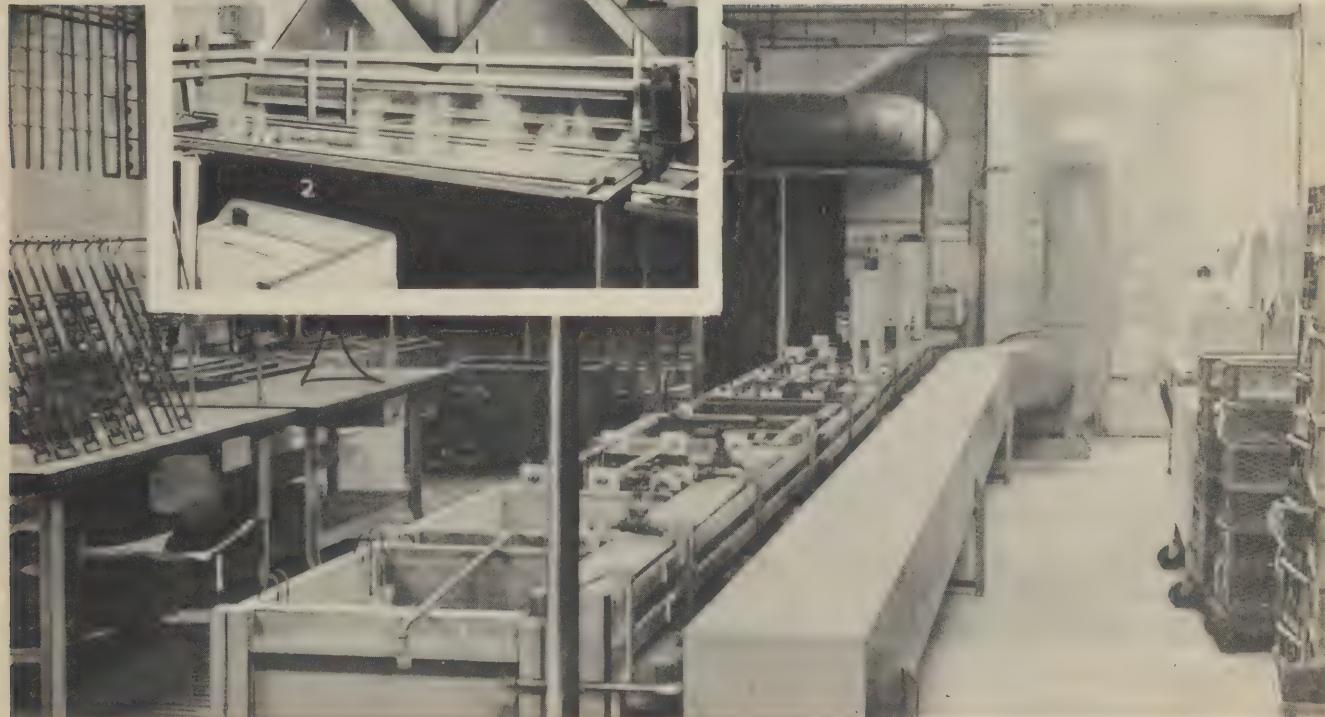
1. Local exhaust ventilation (horizontal slot type preferable).
2. General exhaust ventilation.
3. Isolation of process.
4. Gloves, aprons, face shields, and goggles for operators.
5. Low temperature of solution and reduced rate of operations of process in absence of ventilation.
6. Protective nasal ointments.

HEALTH HAZARDS

Dermatitis may result from chrome, sodium cyanide, hydrofluoric acid, copper sulphate, nickel sulphate and chloride, and caustic soda.

1. SODIUM CYANIDE.—Effects due to hydrogen cyanide, which is a powerful protoplasmic poison and causes a cessation of oxidation in the blood. This may also be absorbed through the skin.
2. CADMIUM OXIDE.—Systemic effects due to edema of lungs and pneumonitis if inhaled. Associated with digestive symptoms if ingested.
3. OXIDES OF NITROGEN.—Cause an edema of the lungs and if in sufficient concentration may cause death.
4. HYDROFLUORIC ACID.—Usually produces a local caustic effect on skin and mucous membrane. There is a small possibility of chronic poisoning.
5. LEAD CARBONATE.—May cause any of symptoms or signs of plumbism.
6. COPPER SULPHATE.—Chronic copper poisoning has not been proved but is thought by some to cause hemochromatosis. Possibility of SO_2 causing upper respiratory irritation can not be overlooked.
7. NICKEL SULPHATE AND CHLORIDE.—Nickel carbonyl (mixture of nickel and carbon) is the only compound of nickel that produces systemic poisoning.
8. PHOSPHORIC ACID.—Slight danger of formation of phosphorus.
9. ACETIC ACID.—May produce temporary irritation of gastrointestinal tract and respiratory tract.
10. CAUSTIC SODA.—May produce a dermatitis or conjunctivitis along with caustic effect.
11. CHROMIC ACID.—Produces dermatitis with chrome ulcers, which are very slow healing.

An example of lateral slot type ventilation.



Small plating tanks provided with lateral slot type ventilation.

SECTION VIII
ENGINE CLEANING

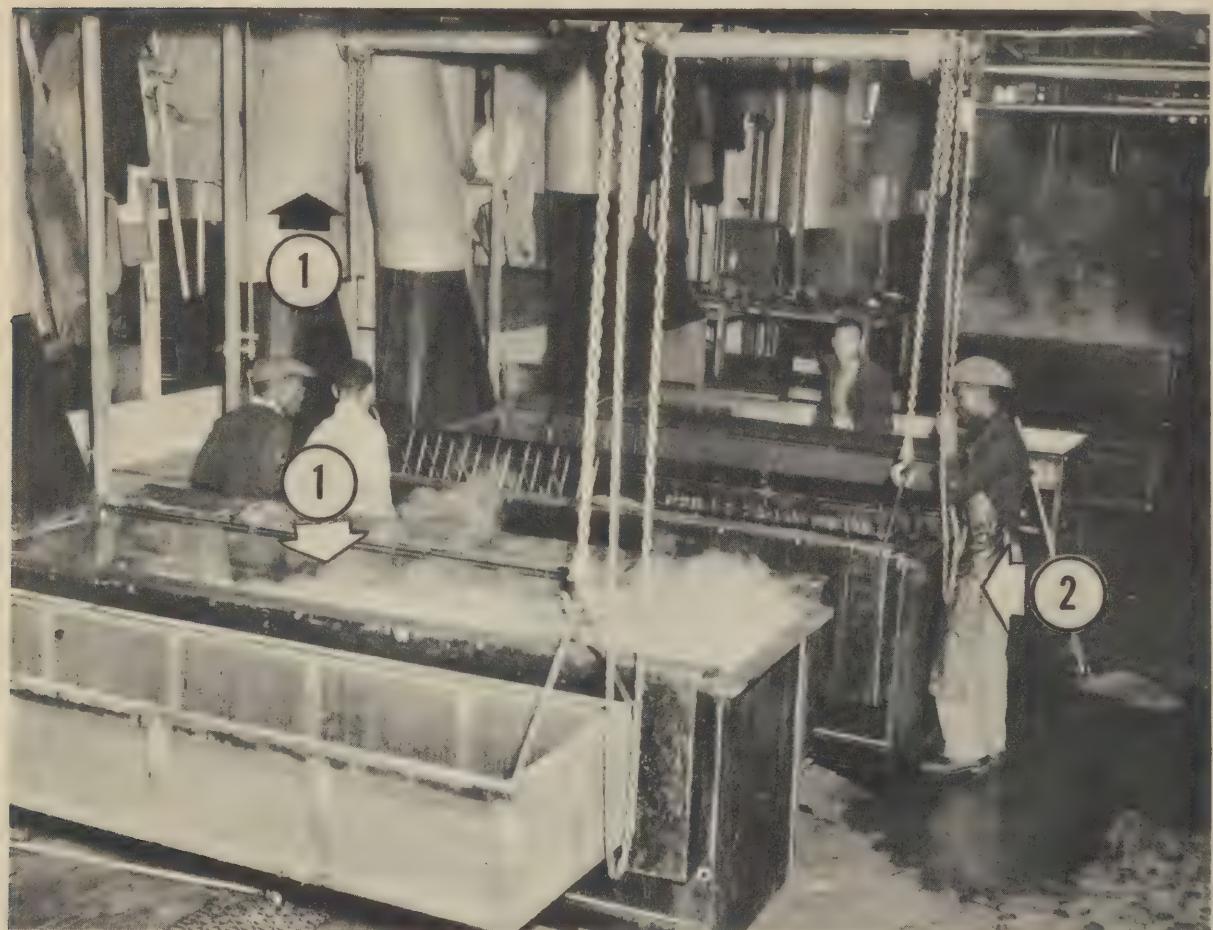
PROCESS.—Engine parts are degreased by hand cleaning methods and by dipping in tanks.

TOXIC AGENTS

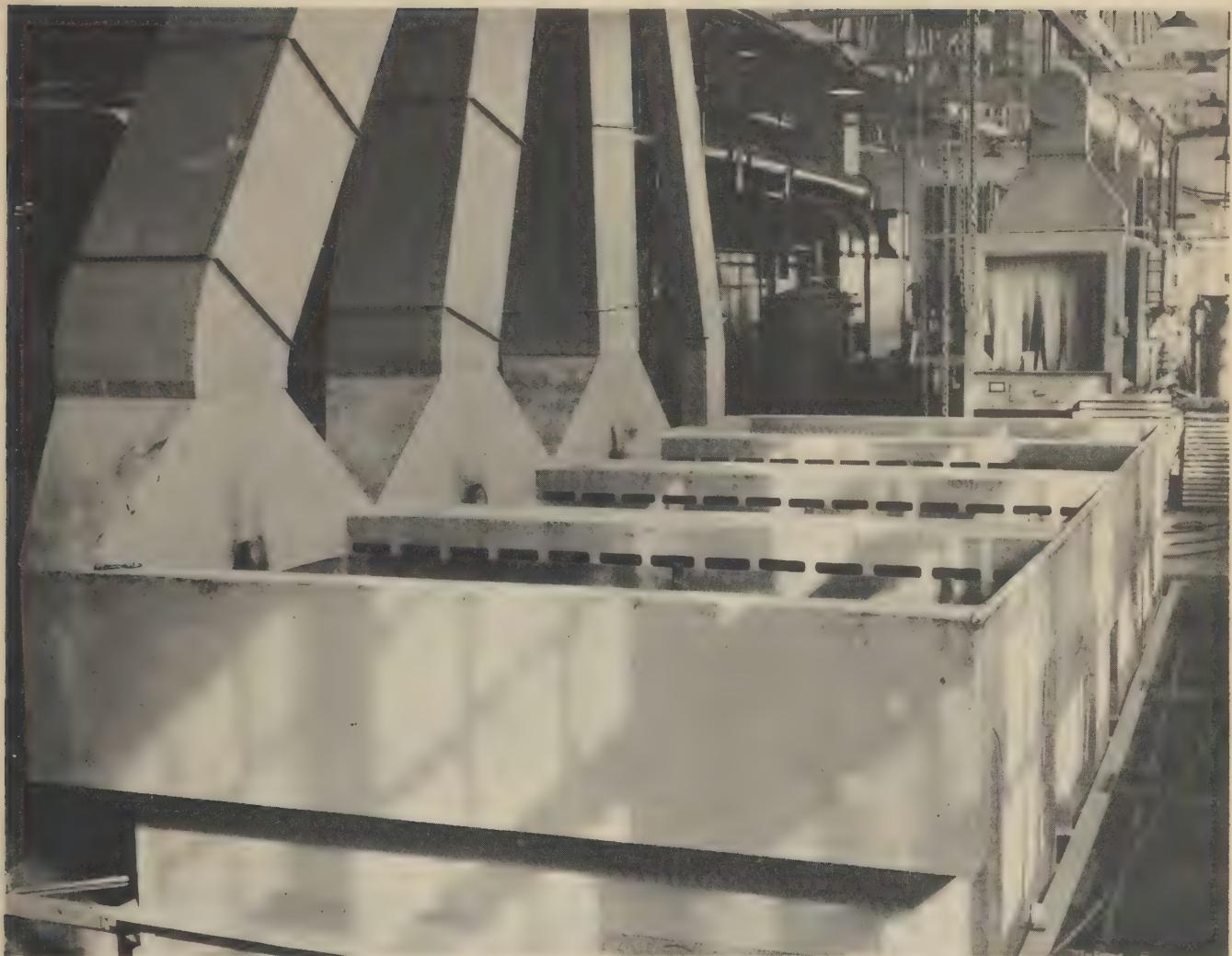
1. Carbon tetrachloride.
2. Turco fuzee (80 percent ethylene dichloride, 20 percent cresol).
3. Mixture (50 percent carbon tetrachloride, 50 percent gasoline).
4. Solvent dry cleaning (petroleum distillate).
5. Caustic cleaners (soda ash, Oakite).
6. Other solvents such as gasoline and turpentine.

SUGGESTED CONTROL MEASURES

1. Local exhaust ventilation (horizontal slot type) and good natural ventilation.
2. Strict personal hygiene.
3. Protective creams and ointments.
4. Protective clothing.
5. Use of lanolin oil hand cleanser.
6. Isolation of process.



1. Local exhaust ventilation.
2. Protective clothing.

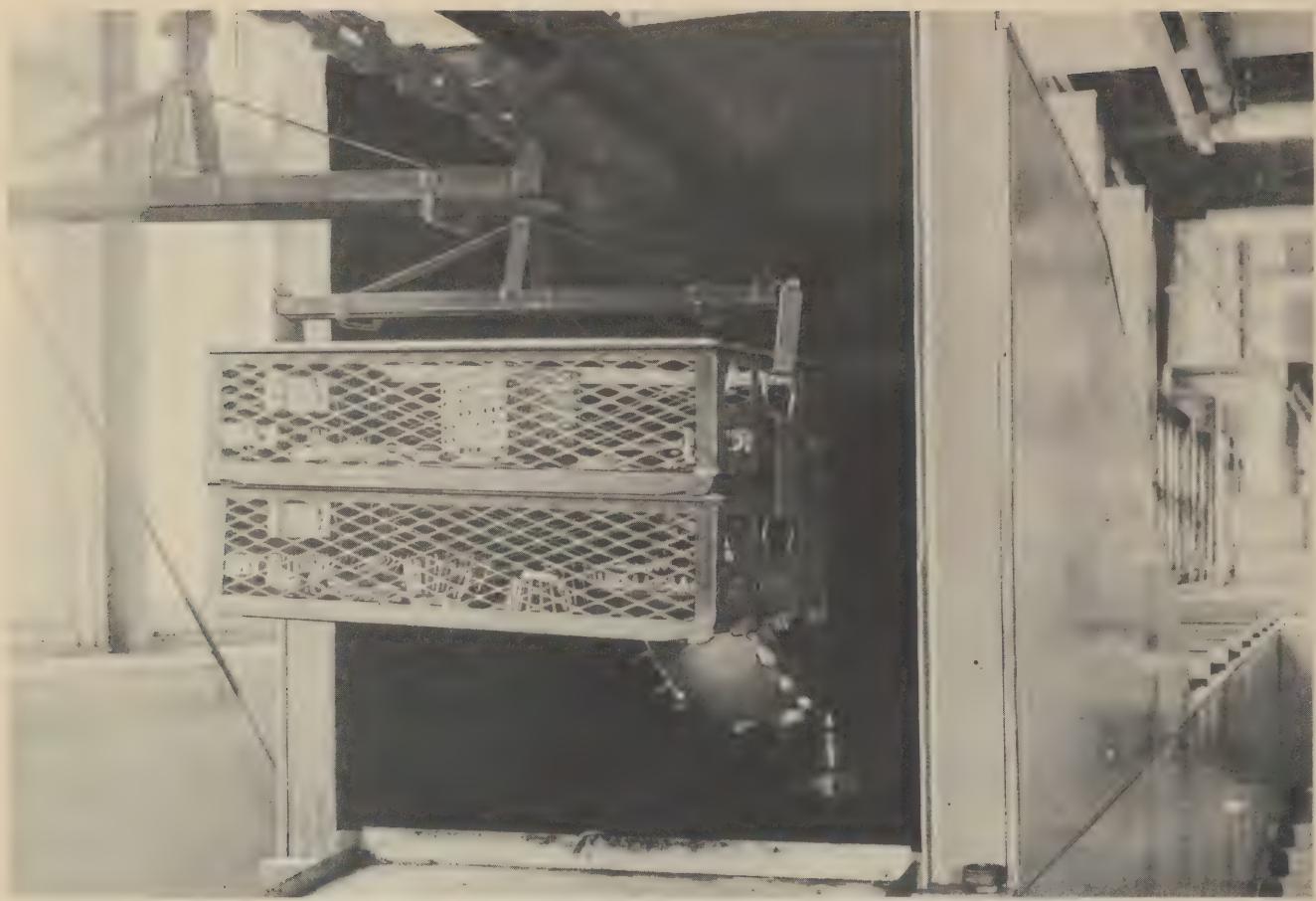


Lateral slot type exhaust ventilation.

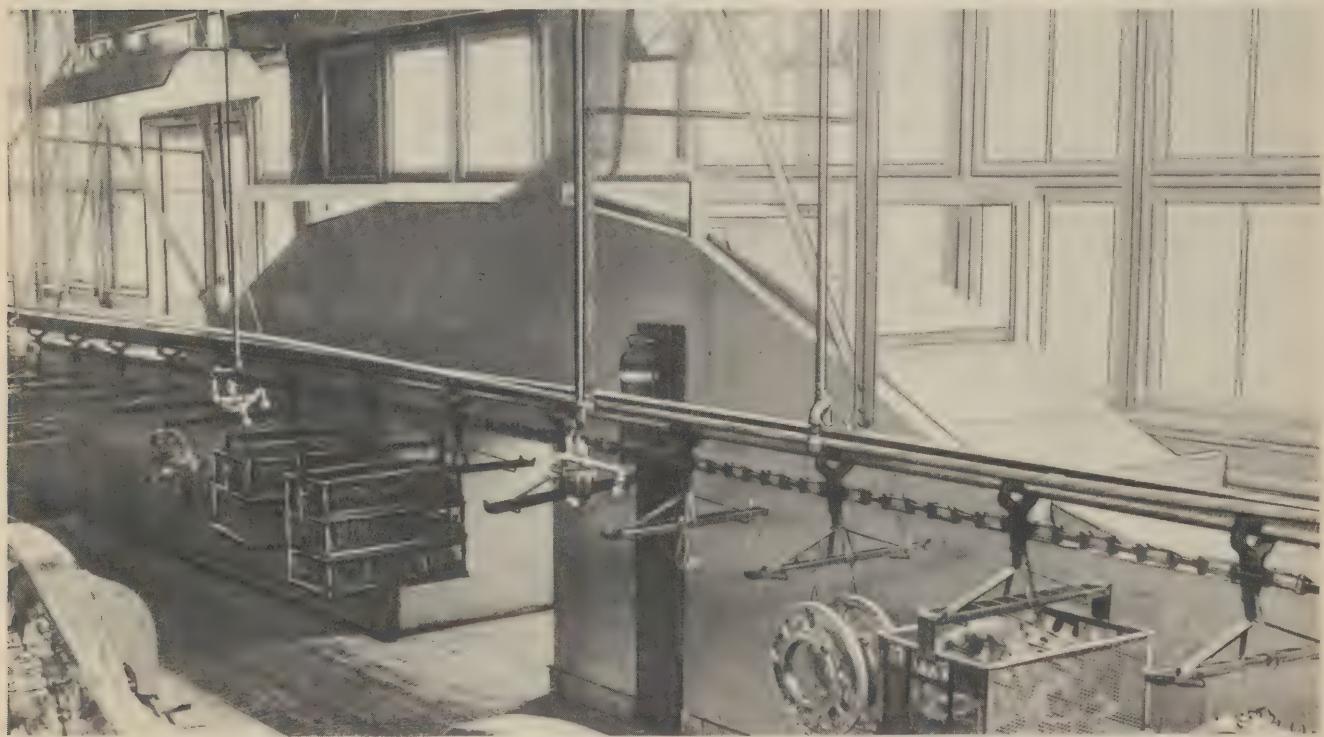
HEALTH HAZARDS

Dermatitis may result from carbon tetrachloride, turco fuzee, gasoline, solvent dry cleaning, caustic cleaners, and turpentine.

1. CARBON TETRACHLORIDE.—If in sufficient concentration may cause an acute narcosis. Most common effect is chronic poisoning which effects primarily the liver and kidneys.
2. TURCO FUZEE (80 percent ethylene dichloride and 20 percent cresol).
 - a. Ethylene dichloride, if in sufficient concentration, is narcotic and if continued over a long period of time will produce edema of lungs and degenerative changes in the kidney.
 - b. Gasoline (petroleum distillate) has an acute narcotic effect and may contain up to 20 percent benzene (benzol).
3. SOLVENT DRY CLEANING (petroleum distillate).—May produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms.
4. CAUSTIC SODA.—May produce a dermatitis or conjunctivitis along with caustic effect.
5. TURPENTINE.—Inhalation of heavy fumes causes symptoms of a mild anesthetic poison. It is excreted by the kidneys and nephritis is not an uncommon result of long exposure to turpentine fumes.



Use of enclosed and exhaust ventilated system in conveyor line cleaning method.



Part of exhaust ventilated and enclosed system in conveyor line cleaning method.

SECTION IX

ENGINE DISASSEMBLY

PROCESS.—Engines are manually disassembled into component parts and partially cleaned.

TOXIC AGENTS

1. Carbon tetrachloride.
2. Mixture of 50 percent carbon tetrachloride, 50 percent gasoline.
3. Solvent dry cleaning commercial petroleum distillate.
4. Oils, greases.
5. Other volatile solvents.

SUGGESTED CONTROL MEASURES

1. Local exhaust (lateral type) or good natural ventilation.
2. Strict personal hygiene, protective clothing, protective ointments and creams, and use of lanolin oil hand cleanser.

HEALTH HAZARDS

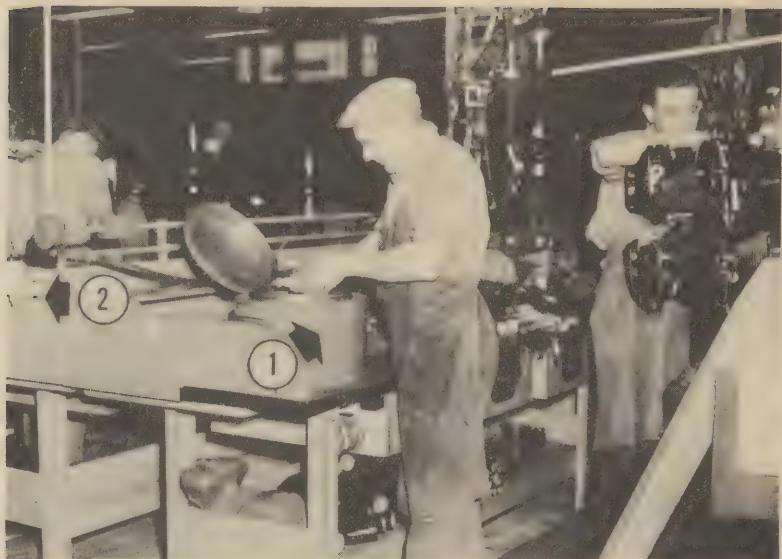
Dermatitis may be caused by carbon tetrachloride, gasoline, petroleum distillates, oils, and greases.

1. **CARBON TETRACHLORIDE.**—In sufficient concentration, may cause an acute narcosis. Most common effect is chronic poisoning, which injures primarily the kidneys and liver.
2. **PETROLEUM DISTILLATES** (gasoline and solvent dry cleaning).—May produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms.
3. **OILS AND GREASES.**—Usual damage is an oil dermatitis which can be controlled by proper corrective measures.



General view of engine disassembly.

1. Hand cleaning of parts using a covered container.
2. Lanolin oil dispenser.



Exhaust ventilated spray cleaning booth.



Spray cleaning in exhaust ventilated booth.



SECTION X

FOUNDRY

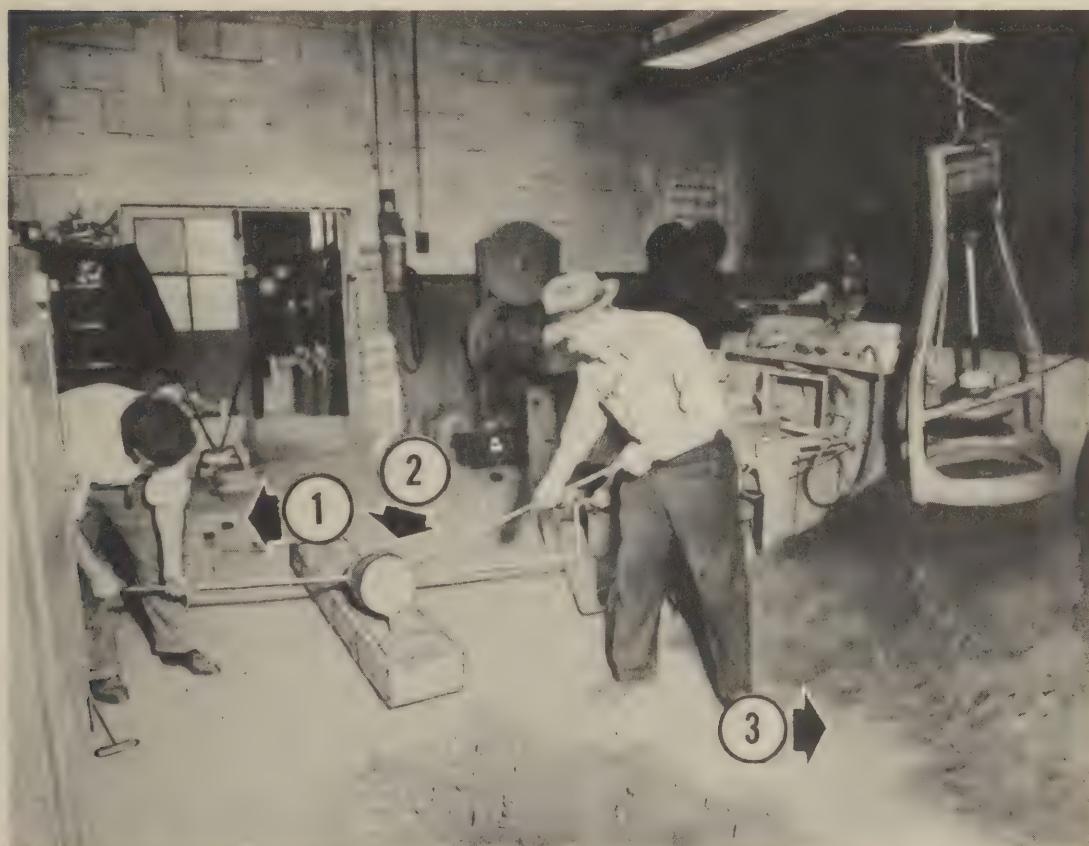
PROCESS.—Molds are prepared, various metals melted and poured into molds, castings removed from molds by "shake out," castings ground and buffed.

| TOXIC AGENTS | SUGGESTED CONTROL MEASURES |
|---------------------|---------------------------------------|
| 1. Silica. | 1. General exhaust ventilation. |
| 2. Carbon monoxide. | 2. Approved type dust respirators. |
| 3. Metal fumes. | 3. Good housekeeping. |
| 4. Excessive heat. | 4. Use of nonsilica parting compound. |

HEALTH HAZARDS

Dermatitis may be caused by fumes of certain metals that are being used in the foundry.

1. SILICA.—May produce silicosis if dust count is not controlled.
2. CARBON MONOXIDE.—If in sufficient concentration, will produce anoxemia, causing unconsciousness and death.
3. METAL FUMES.—May cause different types of poisoning according to the types of metals that are used.
4. EXCESSIVE HEAT.—May produce heat exhaustion with loss of body fluids and chlorides.



1. Possible carbon monoxide from gas furnace. 2. Metal fumes. 3. "Wetted down" sand.

SECTION XI
HEAT TREATING

PROCESS.—Tools and parts are tempered and hardened by heat treating.

TOXIC AGENTS

1. Sodium cyanide.
2. Carbon monoxide.

SUGGESTED CONTROL MEASURES

1. General exhaust ventilation.
2. Individual exhaust pipe for cyanide.
3. Strict personal hygiene.

HEALTH HAZARDS

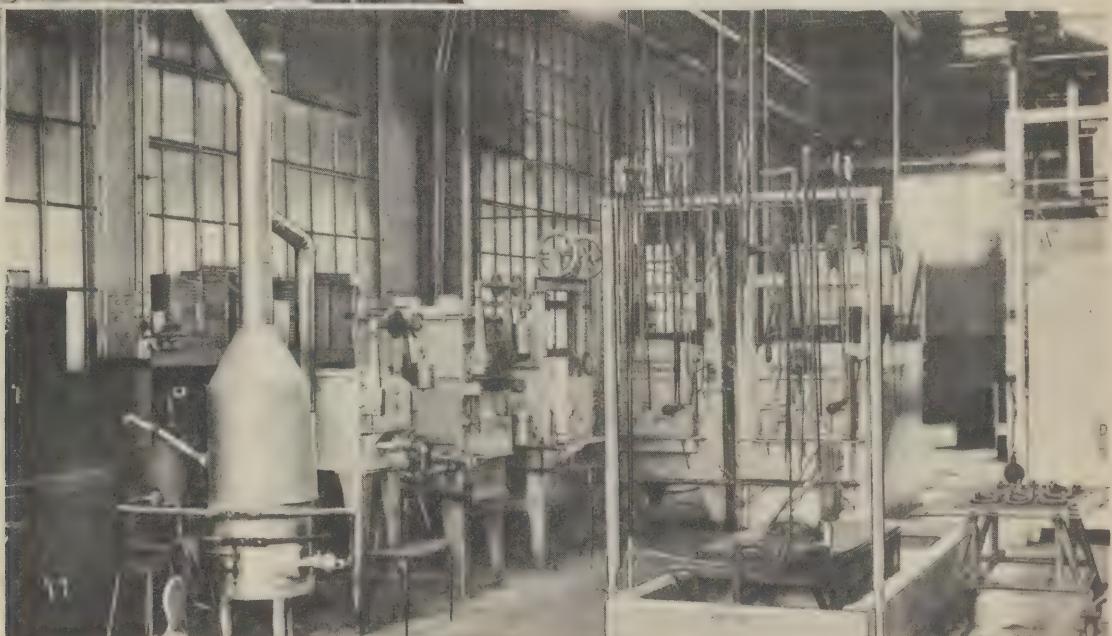
Dermatitis may be caused by cyanides.

1. SODIUM CYANIDE.—Effects usually due to hydrogen cyanide, which is a powerful protoplasmic poison and causes a cessation of oxidation in the blood. This may also be absorbed through the skin.

2. CARBON MONOXIDE.—If in sufficient concentration, will produce anoxemia, causing unconsciousness and death.



Individual exhaust pipe.



Exhaust ventilated cyanide bath.

SECTION XII

HYDRAULIC

PROCESS.—Hydraulic parts of airplanes are disassembled, cleaned, repaired, sometimes brush painted, and reassembled.

TOXIC AGENTS

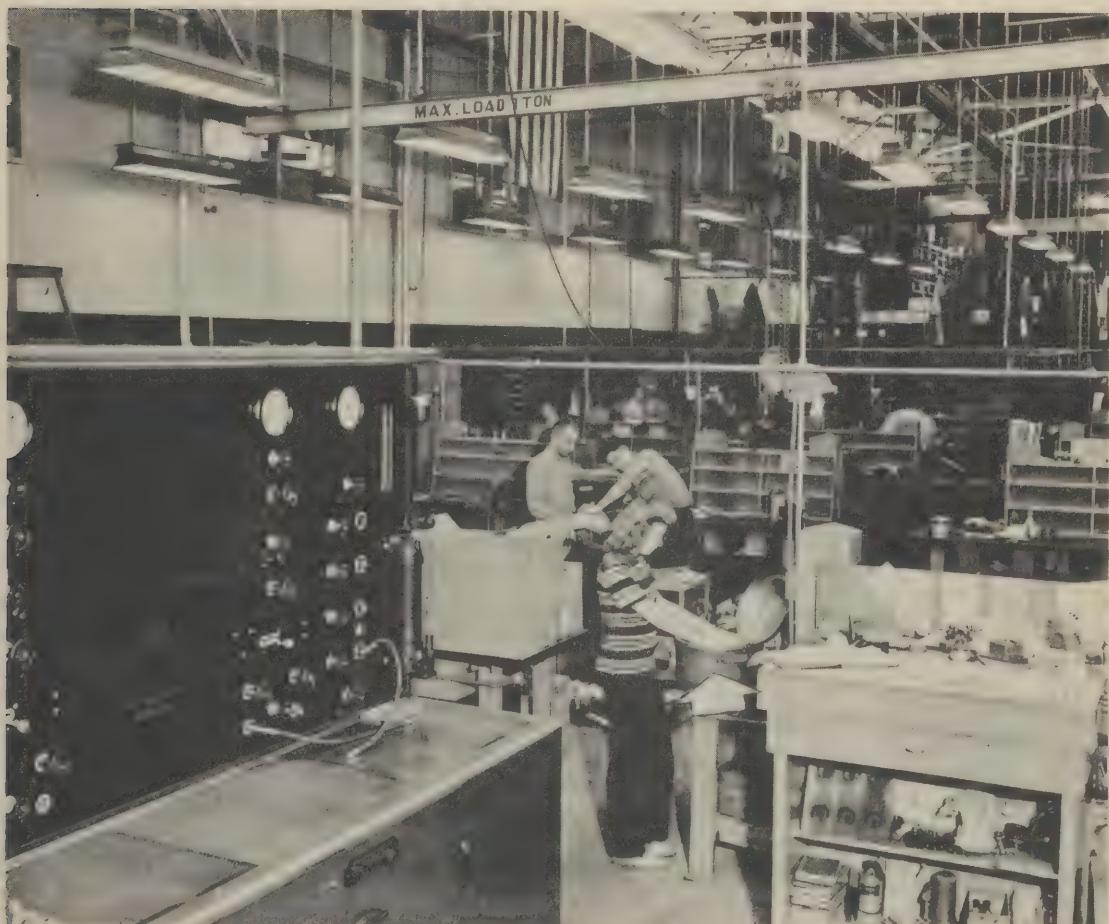
1. Carbon tetrachloride.
2. Solvent dry cleaning (petroleum distillate).
3. Mixture 50 percent carbon tetrachloride and 50 percent kerosene.
4. Benzene.
5. Alcohol.
6. Carbon black.

SUGGESTED CONTROL MEASURES

1. General exhaust ventilation or good natural ventilation.
2. Local exhaust ventilation for continuous cleaning operations.
3. Covered solvent containers.
4. Protective creams and ointments.
5. Strict personal hygiene.
6. Use of gloves where possible.

HEALTH HAZARDS

Dermatitis may result from petroleum distillate, methyl alcohol (usually due to denaturants), carbon tetrachloride, and benzol.



Covered solvent container.

1. CARBON TETRACHLORIDE.—If in sufficient concentration may cause an acute narcosis. Most common effect is chronic poisoning which effects primarily the liver and kidneys.
2. SOLVENT DRY CLEANING (petroleum distillate).—May produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms. Petroleum distillates may also contain benzene.
3. BENZENE (benzol).—Is a very dangerous toxin and usually presents a picture of aplastic anemia. This type of clinical picture is seen after prolonged exposure. The acute type of poisoning produces inebriation.
4. METHYL ALCOHOL.—May produce an acute inebriation with an atrophy of optic nerve, also symptoms of chronic poisoning.
5. CARBON BLACK.—If prolonged, the dust may produce anthracosis.

SECTION XIII

INSTRUMENT REPAIR

PROCESS.—All types of delicate instruments are disassembled, cleaned, reassembled, and calibrated.

TOXIC AGENTS

1. Mixture of 50 percent carbon tetrachloride, 50 percent gasoline.
2. Stoddard's solvent (commercial organic solvent).
3. Solvent dry cleaning (petroleum distillate).
4. Other toxic agents such as ammonia, alcohol, miscellaneous organic solvents

SUGGESTED CONTROL MEASURES

1. Properly designed ventilated spray booth for cleaning.
2. Covered solvent containers.
3. Protective creams and ointments.



Covered solvent container.



*Cleaning table with
lateral exhaust ventilation
to remove solvent vapors.*



1. Spray booth.
2. Ventilation.

HEALTH HAZARDS

Dermatitis may be produced by carbon tetrachloride, gasoline, Stoddard's solvent, solvent dry cleaning, and alcohol.

1. CARBON TETRACHLORIDE.—If in sufficient concentration, may cause an acute narcosis. Most common effect is chronic poisoning, which affects primarily the liver and kidneys.
2. PETROLEUM DISTILLATE (Stoddard's solvent, solvent dry cleaning, gasoline).—May produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms. Petroleum distillates may also contain benzene.
3. ALCOHOL.—May produce an acute inebriation or other changes dependent on type of alcohol used.

SECTION XIV
LUMINOUS DIAL REPAIR

PROCESS.—Used luminous dials are scraped and repainted, and new dials are painted with luminous paint.

TOXIC AGENTS

1. Radioactive luminous paint.
2. Radon.
3. Gamma radiation.

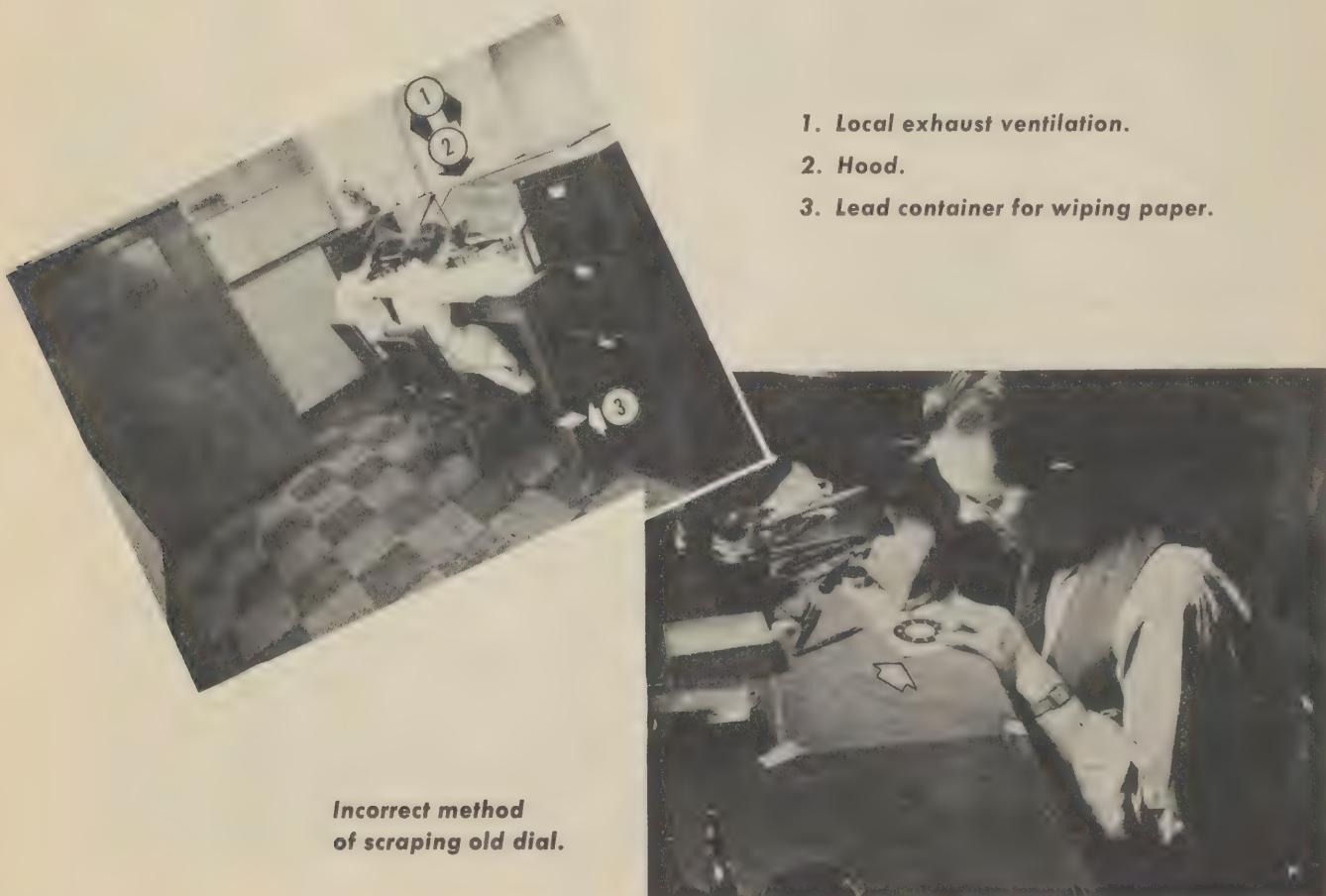
SUGGESTED CONTROL MEASURES

1. Special designed workroom equipped with argon light inspection room, approved hoods, and exhaust ventilation.
2. Compulsory personal hygiene.
3. Proper storage and handling of luminous compound.
4. Good housekeeping.
5. Dry paint removal under liquid or ventilated hood and operator provided with approved supplied air respirator.

HEALTH HAZARDS

Small possibility of burn from gamma radiation.

RADIOACTIVE PAINT.—Greatest possibility is inhalation and ingestion of paints, causing a chronic type of poisoning which affects primarily the bones.





Dial scraping prior to repainting. Note down-draft ventilated table in use at an overseas installation.



Ventilated radium dial storage cabinet.



**Dial painting booths.
Note rounded corners and well designed hoods.**

SECTION XV
MACHINE SHOP

PROCESS.—Airplane parts and tools are machined, finished, and polished.

TOXIC AGENTS

1. Cutting oils and greases.
2. Synthetic resin and asbestos dust.

SUGGESTED CONTROL MEASURES

1. Strict personal hygiene.
2. Protective creams and ointments.
3. Local exhaust ventilation of dusty processes.

HEALTH HAZARDS

Dermatitis may be produced by cutting oils, greases, and synthetic resin.

ASBESTOS.—A prolonged exposure may produce asbestosis.



SECTION XVI
MINOR REPAIR

PROCESS.—Airplanes receive first and second echelon maintenance.

TOXIC AGENTS

1. Carbon tetrachloride.
2. Solvent dry cleaning (petroleum distillate).
3. Mixture 50 percent carbon tetrachloride, 50 percent gasoline.
4. Small quantities other toxic agents such as benzol, gasoline, toluene, acetone, amyl acetate, lead, ethyl alcohol, butyl alcohol, ethyl acetate, butyl acetate, petroleum naphtha, turpentine, caustic cleaners, oils, and greases.

SUGGESTED CONTROL MEASURES

1. General exhaust or good natural ventilation.
2. Local exhaust ventilation for cleaning inside of planes.
3. Protective hand cream.
4. Strict personal hygiene.
5. Good housekeeping.
6. Other measures are covered solvent containers and isolation of paint and dope operations.



Minor repair.

HEALTH HAZARDS

Dermatitis may be caused by carbon tetrachloride, petroleum distillate (gasoline and petroleum naphtha), benzol, toluene, acetone, amyl acetate, lead, ethyl alcohol, butyl alcohol, ethyl acetate, butyl acetate, turpentine, caustic cleaners, oils, and greases.

1. CARBON TETRACHLORIDE.—If in sufficient concentration may cause an acute narcosis. Most common effect is chronic poisoning which injures primarily the kidneys and liver.
2. PETROLEUM DISTILLATES (gasoline and petroleum naphtha).—May produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms.
3. BENZENE (benzol).—Is a very toxic material and usually presents a picture of aplastic anemia. This type of clinical picture is seen after prolonged exposure. The acute type of poisoning produces inebriation.
4. TOLUENE.—If in sufficient concentration has a narcotic action. May produce death. Toluene is methyl benzene.
5. ACETONE.—There are no cases of poisoning reported in man. Experimentally on animals, has an acute narcotic effect.
6. ACETATE (amyl, butyl and ethyl).—Slight possibility of causing irritation of eyes and respiratory passages and mildly anesthetic. There are no fatal poisoning cases reported in man.
7. ALCOHOL (butyl).—May produce blood changes with renal and hepatic degeneration if inhaled over a long period of time.
8. TURPENTINE.—Inhalation of heavy fumes causes symptoms of a mild anesthetic poison. It is excreted by the kidneys and nephritis is not an uncommon result of long exposure to turpentine fumes.
9. CAUSTIC CLEANER.—May produce dermatitis and conjunctivitis along with caustic effect.
10. OILS AND GREASES.—Usual damage is an oil dermatitis which can be controlled by proper corrective measures.

SECTION XVII

MOTOR VEHICLE AND MISCELLANEOUS REPAIR

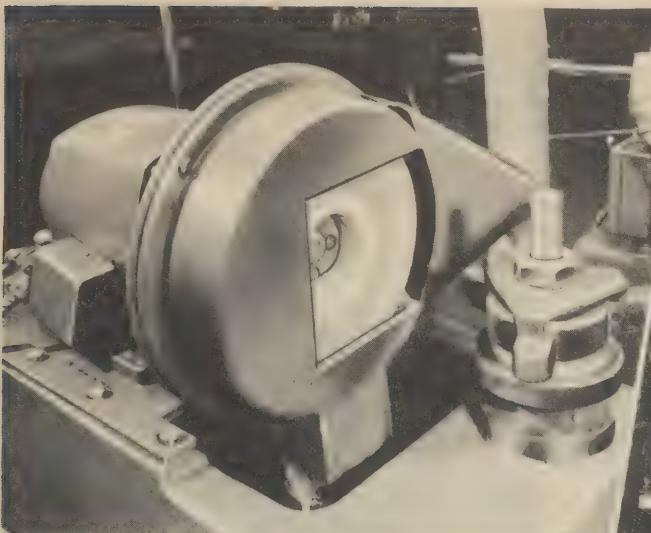
PROCESS.—Repair of gasoline motors and related equipment.

| TOXIC AGENTS | SUGGESTED CONTROL MEASURES |
|----------------------|---|
| 1. Carbon monoxide. | 1. Local exhaust ventilation. |
| 2. Gasoline. | 2. Protective clothing, gloves, aprons. |
| 3. Lead. | 3. Approved-type air line respirators for continued exposure or approved-type toxic dust respirator for intermittent exposures to dusty operations. |
| 4. Asbestos. | 4. Protective hand creams. |
| 5. Oils and greases. | 5. Strict personal hygiene. |

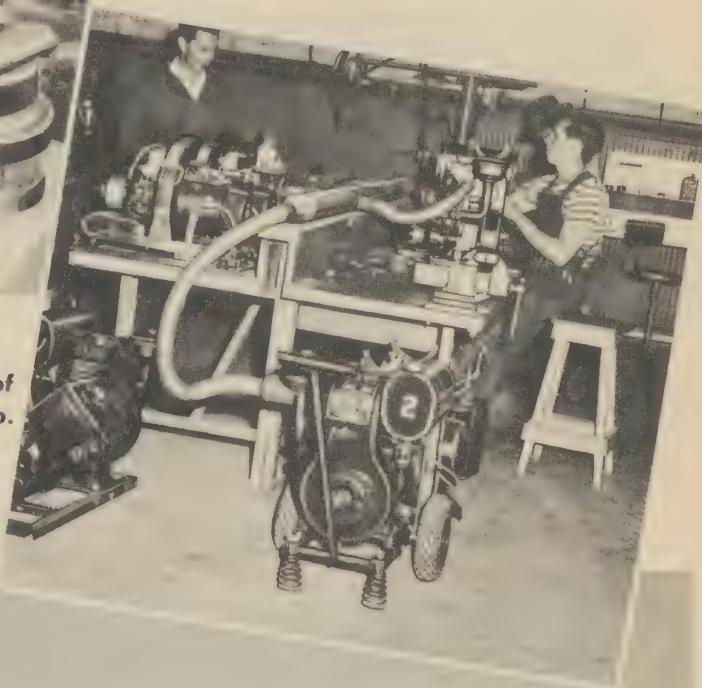
HEALTH HAZARDS

Dermatitis may be caused by petroleum distillate (gasoline and petroleum naphtha), oils, and greases.

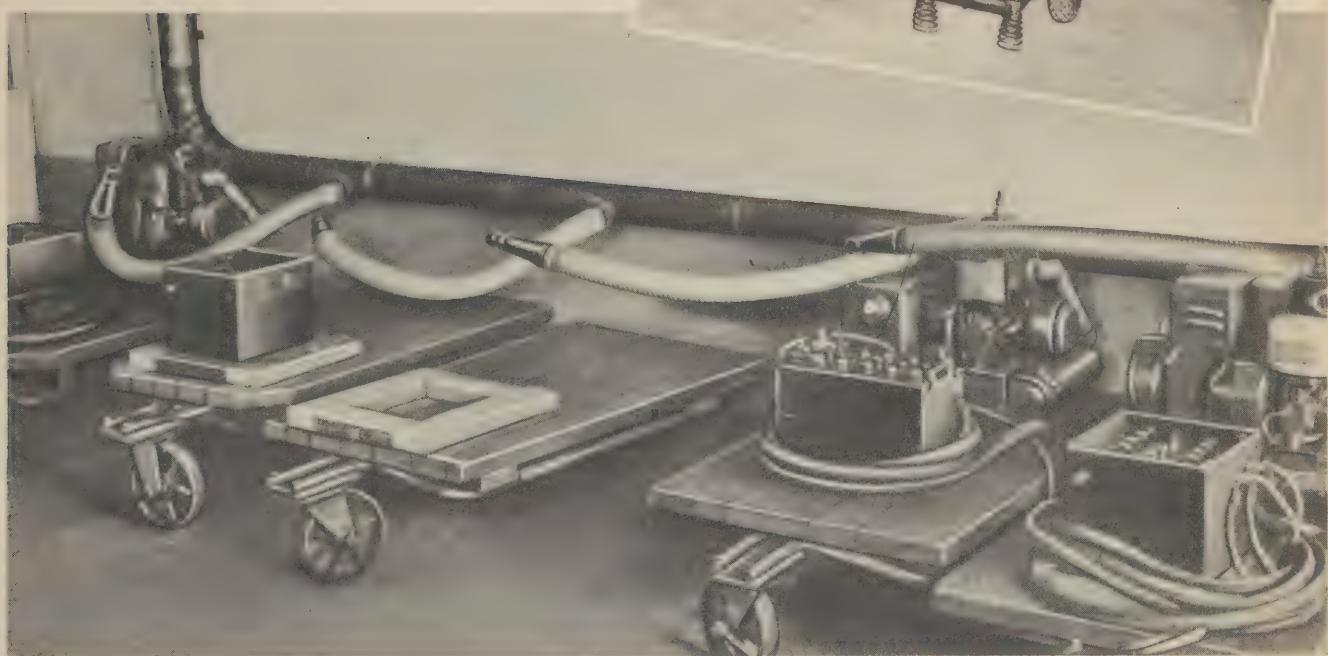
1. CARBON MONOXIDE.—If in sufficient concentration, will produce anoxemia, causing unconsciousness and death.



Exhaust ventilated grinding wheel
for brake shoe grinding.



Exhaust ventilating system for removal of
carbon monoxide during motor tune-up.



Exhaust ventilating system for removal of carbon monoxide during motor tune-up.

2. GASOLINE.—May produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms.
3. LEAD.—May produce any of the symptoms and signs of plumbism.
4. ASBESTOS.—A prolonged exposure may produce asbestosis.
5. OILS AND GREASES.—Usual damage is an oil dermatitis which can be controlled by proper corrective measures.

SECTION XVIII
OFFICE APPLIANCES

PROCESS.—Typewriters are cleaned, repaired, and adjusted.

TOXIC AGENTS

1. Naphtha.
2. Benzene.
3. Carbon tetrachloride.
4. Kerosene.

SUGGESTED CONTROL MEASURES

1. Local exhaust ventilation.
2. Isolation of process.
3. Protective clothing.
4. Protective creams and ointments.

HEALTH HAZARDS

Dermatitis may be caused by carbon tetrachloride, petroleum distillates (petroleum naphtha, kerosene), and benzene.

1. **CARBON TETRACHLORIDE.**—If in sufficient concentration may cause an acute narcosis. Most common effect is chronic poisoning which injures primarily the kidneys and liver.

2. **BENZENE (benzol).**—Is a very toxic material and usually presents a picture of aplastic anemia. This type of clinical picture is seen after prolonged exposure. The acute type of poisoning produces inebriation.

3. **PETROLEUM DISTILLATES** (petroleum naphtha, kerosene).—May produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms.

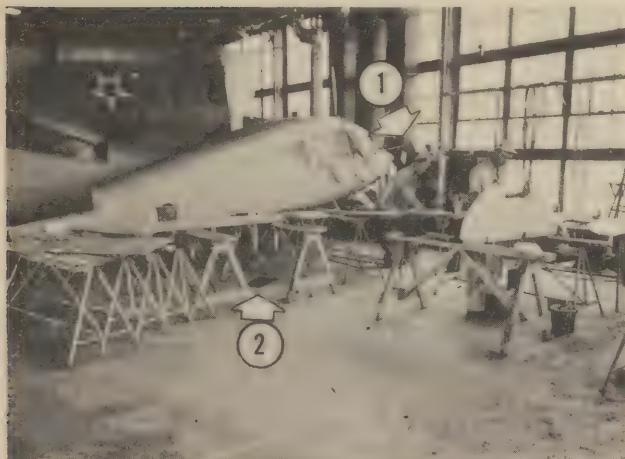


Note the absence of ventilation for solvent spraying.

SECTION XIX

PAINT AND DOPE

PROCESS.—Surfaces of airplanes such as bodies, wings, etc., are doped (spray and hand), and painted (spray and hand).



Hand painting and dope.

1. Position of work.
2. Downdraft general exhaust ventilation.



Spray paint and dope.

1. Booth enclosure.
2. Exhaust fans.



Using a supplied air respirator in vehicle spray painting.



**Hand application of paint and dope to fabric-covered wing sections.
Downdraft exhaust ventilation through floor grilles should be employed.**

TOXIC AGENTS

1. Benzol.
2. Toluene.
3. Acetone.
4. Amyl acetate.
5. Lead paint.
6. Other toxic agents such as ethyl alcohol, butyl alcohol, ethyl acetate, butyl acetate, petroleum naphtha, turpentine.

SUGGESTED CONTROL MEASURES

1. Local exhaust ventilation (booth).
2. Approved supplied air respirator.
3. Approved chemical cartridge-type respirator for short exposures.
4. Closed solvent containers and separate storage of bulk solvents.
5. Isolation of process.

HEALTH HAZARDS

Dermatitis may be produced by benzol, toluene, acetone, acetates, lead paint, alcohols, turpentine, and petroleum naphtha.

1. BENZOL.—Is a very toxic material and usually presents a picture of aplastic anemia. This type of clinical picture is seen after prolonged exposure. The acute type of poisoning produces inebriation.
2. TOLUENE.—If in sufficient concentration, has a narcotic action and may produce death. Toluene is methyl benzene.
3. ACETONE.—There are no cases of poisoning reported in man. Experimentally on animals has an acute narcotic effect.
4. ACETATES (amyl, butyl, ethyl).—Slight possibility of causing irritation of eyes and respiratory passages and is slightly anesthetic.
5. LEAD PAINTS.—May produce any of characteristic signs or symptoms of plumbism.
6. ALCOHOL (ethyl and butyl).—May produce blood changes with renal and hepatic degeneration if inhaled over a long period of time.
7. PETROLEUM NAPHTHA.—May produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms.
8. TURPENTINE.—Inhalation of heavy fumes causes symptoms of a mild anesthetic poison. It is excreted by the kidneys and nephritis is not an uncommon result of long exposure to turpentine fumes.

SECTION XX
PLEXIGLAS

PROCESS.—Plexiglas is drilled, ground, cut, and shaped.

TOXIC AGENTS

1. Small quantities ethylene dichloride and monomeric methyl methacrylate.

SUGGESTED CONTROL MEASURES

1. General exhaust or good natural ventilation.
2. Covered solvent containers.

HEALTH HAZARDS

Ethylene dichloride may produce dermatitis.

ETHYLENE DICHLORIDE.—May produce an acute anesthetic action and, if prolonged, may produce death. Action similar to that of carbon tetrachloride and chloroform.



SECTION XXI

PROPELLER

PROCESS.—Airplane propellers are dismantled, cleaned, adjusted, reassembled, and balanced.

TOXIC AGENTS

1. Trichloroethylene.
2. Carbon tetrachloride.
3. Solvent dry cleaning (petroleum distillate).
4. Small amounts of oils and greases.

SUGGESTED CONTROL MEASURES

1. Local exhaust ventilation (horizontal slot type).
2. Protective hand creams.
3. Strict personal hygiene and use of gloves where possible.
4. Lower temperature of solvent and reduce rate of operation.

HEALTH HAZARDS

Dermatitis may be caused by trichloroethylene, solvent dry cleaning, and oils and greases.

1. TRICHLOROETHYLENE.—In sufficient concentration, is an acute narcotic poison which is almost double that of carbon tetrachloride. In the presence of a flame, the vapors may form phosgene. Long continued exposure to trichloroethylene has been held responsible for lesions to the optic and trigeminal nerves, and may exert a damaging effect on any part of the central nervous system.
2. SOLVENT DRY CLEANING.—May produce an acute anesthetic action or may produce a chronic type of poisoning, usually associated with nervous symptoms.
3. OILS AND GREASES.—Usual damage is an oil dermatitis which can be controlled by proper corrective measures.
4. CARBON TETRACHLORIDE.—If in sufficient concentration, may cause an acute narcosis. Most common effect is chronic poisoning which injures permanently the kidneys and liver.



Cleaning operations and improper ventilation.

SECTION XXII

RADIATOR AND TANK

PROCESS.—Radiators are dismantled, cleaned, repaired, and reassembled; metal tanks are cleaned and repaired.

TOXIC AGENTS

1. Lead.
2. Ultraviolet radiations.
3. Gasoline.
4. Carbon monoxide.
5. Caustic cleaning solutions (soda ash).
6. Other toxic agents such as metal fumes, hydrochloric acid, gaseous decomposition of rod coatings.

SUGGESTED CONTROL MEASURES

1. Local exhaust ventilation (hood type).
2. General exhaust ventilation.
3. Goggles (gas weld).
4. Protective hand creams.



*Local exhaust ventilation
for solder pot.*



Solvent cleaning of oil coolers. Note the use of exhaust ventilation.



Exhaust ventilation for dipping radiators in hot metal to release cores.

HEALTH HAZARDS

Dermatitis may result from lead, ultraviolet radiation, gasoline, caustic cleaning solutions, hydrochloric acid, and fluorides.

1. LEAD.—May produce any of symptoms or signs associated with plumbism.
2. ULTRAVIOLET RADIATION.—May produce flash burn of the eyes associated with intense pain and photophobia.
3. GASOLINE.—May produce an acute anesthetic action or may produce a chronic type of poisoning usually associated with nervous symptoms.
4. CARBON MONOXIDE.—If in sufficient concentration will produce anoxemia causing unconsciousness and death.
5. CAUSTIC CLEANING SOLUTIONS.—May produce a dermatitis and conjunctivitis along with caustic effect.
6. METAL FUMES.—May produce metal fume fever along with chronic poisoning from metals being welded.
7. HYDROCHLORIC ACID.—Usual danger is from spillage in open flame. Possibility of production of phosgene, which may produce edema of the lungs and death.
8. ROD COATING.—Gaseous decomposition of welding rods used to weld monel contain fluorine, which is an irritant to upper respiratory tract and skin.

SECTION XXIII

RUBBER TANK REPAIR

PROCESS.—Self-sealing rubber tanks are cleaned, patched, and recoated.

| TOXIC AGENTS | SUGGESTED CONTROL MEASURES |
|---|--|
| 1. Benzol. | 1. General exhaust ventilation. |
| 2. Ethylene dichloride. | 2. Local exhaust ventilation or blow (tanks). |
| 3. Toluene. | 3. Covered solvent containers. |
| 4. Gasoline. | 4. Segregation of process. |
| 5. Other toxic agents such as ethyl acetate, ethyl alcohol, methyl ethyl ketone, petroleum naphtha. | 5. Other measures are strict personal hygiene, protective clothing, protective ointments and creams. |

HEALTH HAZARDS

Dermatitis may be caused by benzol, ethylene dichloride, toluene, gasoline, ethyl acetate, ethyl alcohol, methyl ethyl ketone, and petroleum naphtha.

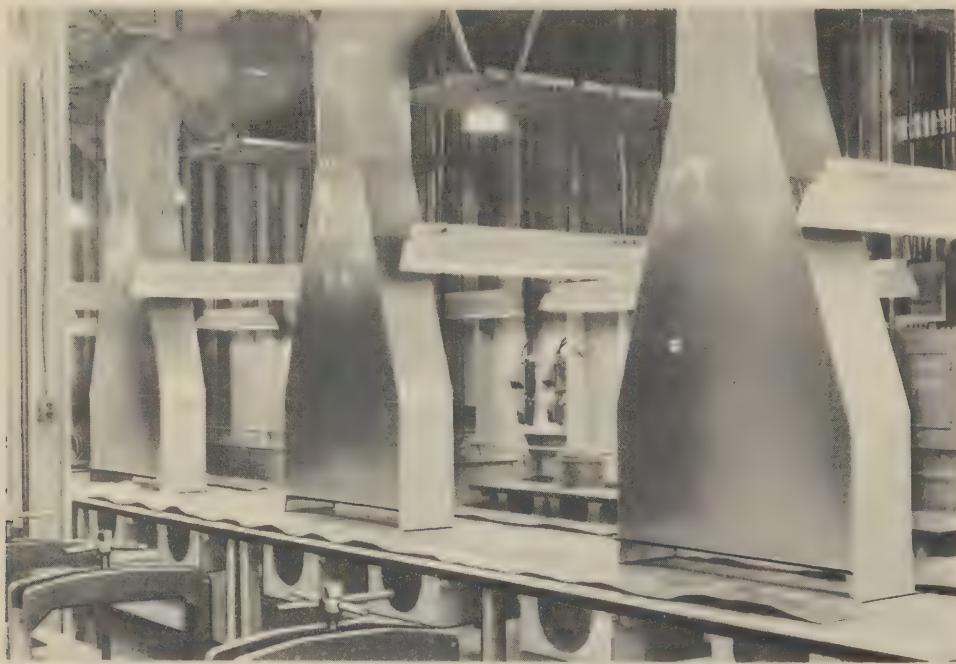
1. **BENZENE** (benzol).—Is a very toxic material and usually presents a picture of aplastic anemia. This type of clinical picture is seen after prolonged exposure. The acute type of poisoning produces inebriation.
2. **TOLUENE**.—If in sufficient concentration, has a narcotic effect and may produce death. Toluene is methyl benzene.
3. **PETROLEUM DISTILLATES** (gasoline and petroleum naphtha).—May produce an acute anesthetic action or produce a chronic type of poisoning usually associated with nervous symptoms.



Exhaust ventilation of fuel cells.



Using a supplied air respirator in entering a fuel cell.



Lateral exhaust ventilation on table used for de-icer repair.

4. ETHYL ACETATE.—Slight possibility of causing irritation of eyes and respiratory passages. Is mildly anesthetic.
5. ETHYL ALCOHOL.—May produce an acute inebriation or, if used over a long period of time, produce damage to liver and kidneys.
6. ETHYLENE DICHLORIDE.—May produce an acute anesthetic action and, if prolonged, may produce death. Action similar to that of carbon tetrachloride and chloroform.
7. METHYL ETHYL KETONE.—Experimentally on animals has an acute narcotic effect. There are no cases of poisoning reported in man.

SECTION XXIV

SANDBLASTING

PROCESS.—Engine parts and castings are cleaned by sandblasting.

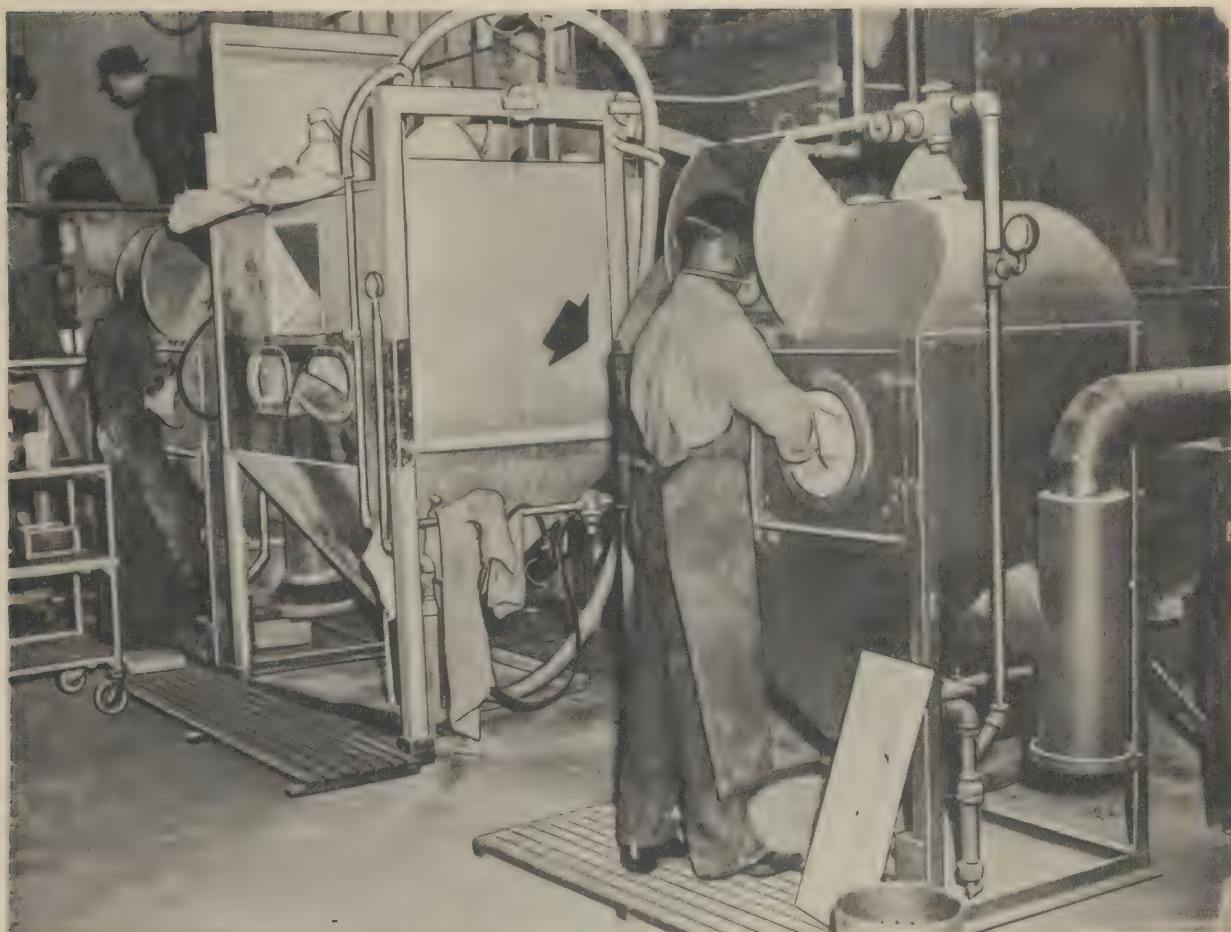
TOXIC AGENTS

1. Silica.
2. Lead.
3. Cadmium.

SUGGESTED CONTROL MEASURES

1. Commercial cabinet of proper design.
2. Substitution of steel grit for sand.
3. Approved-type dust respirator (temporary operations).
4. Approved-type supplied air respirator.
5. Rubber gloves and aprons.
6. Isolation of process.
7. Good housekeeping and maintenance of equipment.
8. Strict personal hygiene.

Commercial cabinet and protective clothing.



HEALTH HAZARDS

Dermatitis may be caused by lead.

1. SILICA.—Persons exposed to dust, especially silica, over a long period of time may develop pneumoconiosis.
2. LEAD.—May produce any of the characteristic signs and symptoms of plumbism.
3. CADMIUM.—Systemic effects due to edema of the lungs and pneumonitis if inhaled; associated with digestive symptoms if ingested.

SECTION XXV
SPARK PLUG CLEANING

PROCESS.—Spark plugs are disassembled, points cleaned by sandblasting, repaired, adjusted, and tested.

TOXIC AGENTS

1. Silica.
2. Carbon tetrachloride.
3. Solvent dry cleaning (petroleum distillate).

SUGGESTED CONTROL MEASURES

1. Local exhaust ventilation.
2. Approved air-line respirators.
3. Approved dust-type respirator.
4. Isolation of process.
5. Substitution of nontoxic materials.

HEALTH HAZARDS

Dermatitis may result from carbon tetrachloride and solvent dry cleaners.

1. SILICA.—May produce silicosis if dust count is not controlled.
2. CARBON TETRACHLORIDE.—If in sufficient concentration may cause an acute narcosis. Most common effect is chronic poisoning, which effects primarily the liver and the kidneys.
3. SOLVENT DRY CLEANER (petroleum distillate).—May produce an acute anesthetic action or may produce a chronic type of poisoning associated mainly with nervous symptoms. Petroleum distillate may also contain benzene.

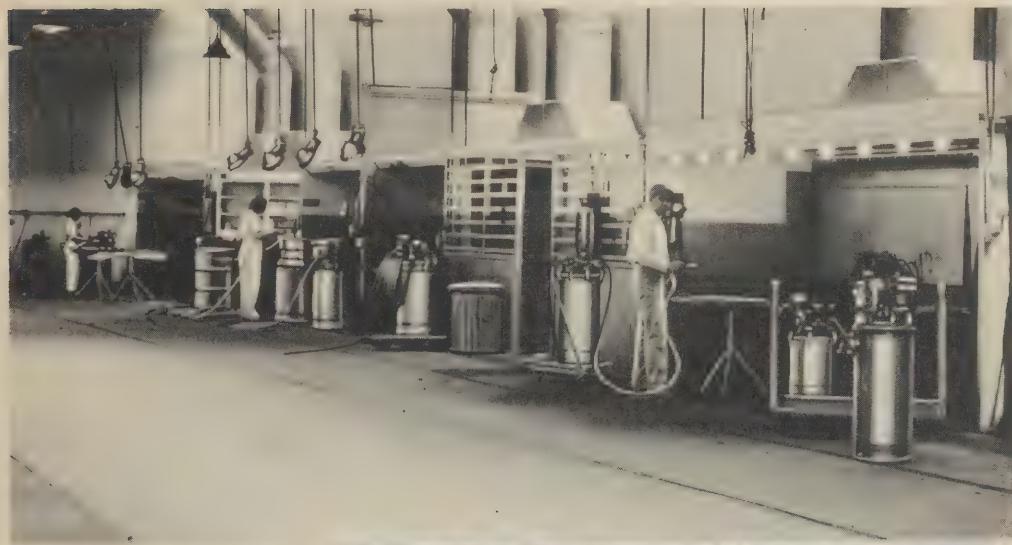


Exhaust ventilated booth for removal of solvent vapors.

SECTION XXVI
SPRAY PAINTING

PROCESS.—Engine parts such as crankcases, exhaust pipes, and new castings are spray painted.

| TOXIC AGENTS | SUGGESTED CONTROL MEASURES |
|---|--|
| 1. Lead. | 1. Water curtain spray booth properly ventilated. |
| 2. Toluene. | 2. Approved chemical cartridge-type respirator for temporary operations. |
| 3. Xylene. | 3. Isolation of process. |
| 4. Turpentine. | 4. Bulk solvents stored separately. |
| 5. Mineral spirits. | |
| 6. Naphthenate. | |
| 7. Metallic paint pigments. | |
| 8. Thinners such as ethyl alcohol, butyl alcohol, amyl acetate, butyl acetate, ethyl acetate, petroleum naphtha, and sometimes benzene. | |



Paint spray booths.

Water curtain ventilated spray booth.





Water curtain
ventilated spray booth.



Paint spray
booth.

HEALTH HAZARDS

Dermatitis may be caused by lead, toluene, xylene, turpentine, naphthenate, metallic paint pigments, alcohol, butyl acetate, ethyl acetate, petroleum naphtha, and benzene (benzol).

1. LEAD.—May produce any of the characteristic signs and symptoms of plumbism.
2. TOLUENE AND XYLENE.—In sufficient concentration, have narcotic action and may produce death. Toluene is methyl benzene and xylene is dimethyl benzene.
3. TURPENTINE.—Inhalation of heavy fumes causes symptoms of a mild anesthetic poison. It is excreted by the kidneys and nephritis is not an uncommon result of long exposure to turpentine fumes.
4. NAPHTHENATE AND NAPHTHA (petroleum distillates).—May produce an acute anesthetic action or produce a chronic type of poisoning usually associated with nervous symptoms. Petroleum distillates may also contain benzene.
5. METALLIC PAINT PIGMENTS.—May produce any type of metallic poisoning as long as metal is contained in paint.
6. BUTYL ALCOHOL.—May produce blood changes with renal and hepatic degeneration if inhaled over a long period of time.
7. BUTYL AND ETHYL ACETATE.—May cause a slight irritation of the eyes and air passages. Strong vapors are slightly anesthetic.
8. BENZENE.—Is a very toxic material and usually presents a picture of aplastic anemia. This type of chemical picture is seen after prolonged exposure. The acute type of poisoning produces inebriation.

SECTION XXVII

TRICHLOROETHYLENE DEGREASING

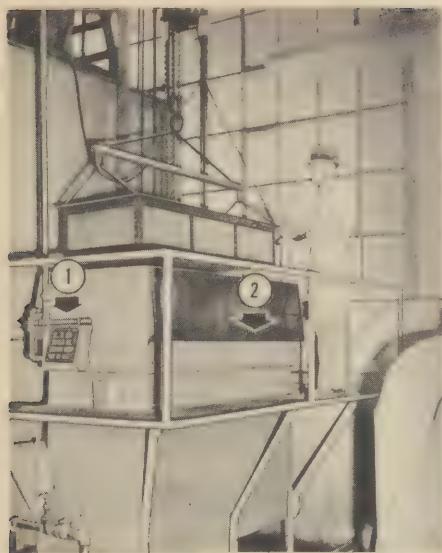
PROCESS.—Engine parts are degreased by dipping in a tank.

| TOXIC AGENTS | SUGGESTED CONTROL MEASURES |
|-----------------------|--|
| 1. Trichloroethylene. | <ol style="list-style-type: none">1. Local exhaust (horizontal slot type) ventilation.2. Proper installation and operation of commercial degreasers.3. Use of gloves and protective creams.4. Reduce solvent level and rate of operation.5. Keep lid of tank closed as much as possible.6. Approved air-line type respirator for cleaning sumps.7. Observe all precautions as recommended by manufacturer of equipment.8. Isolation of process. |

HEALTH HAZARDS

Dermatitis may be caused by trichloroethylene.

TRICHLOROETHYLENE.—In sufficient concentration is an acute narcotic poison which is almost double that of carbon tetrachloride. In the presence of a flame, the vapors may form phosgene. Long continued exposure to trichloroethylene has been held responsible for lesions to the optic and trigeminal nerves, and may exert a damaging effect on any part of the central nervous system. Trichloroethylene may also cause dermatitis.



1. Follow manufacturer's instructions, "Lid must be closed when not in use."
2. Water jacket condenser for condensing vapors.



Water jacketed degreaser with hinged covers. This is mechanically exhausted and thermostatically controlled. Follow instructions carefully. Keep doors closed. Do not breathe toxic vapors.

SECTION XXVIII

WELDING

PROCESS.—Various metal parts are welded by means of an electric welding arc or oxyacetylene welding torch.

TOXIC AGENTS

1. Ultraviolet and infrared radiations.
2. Metal fumes.
3. Gaseous decomposition of rod coating.
4. Excessive heat.
5. Fluorides (when welding monel).
6. Other toxic substances are possible, such as oxides of nitrogen, and carbon monoxide.

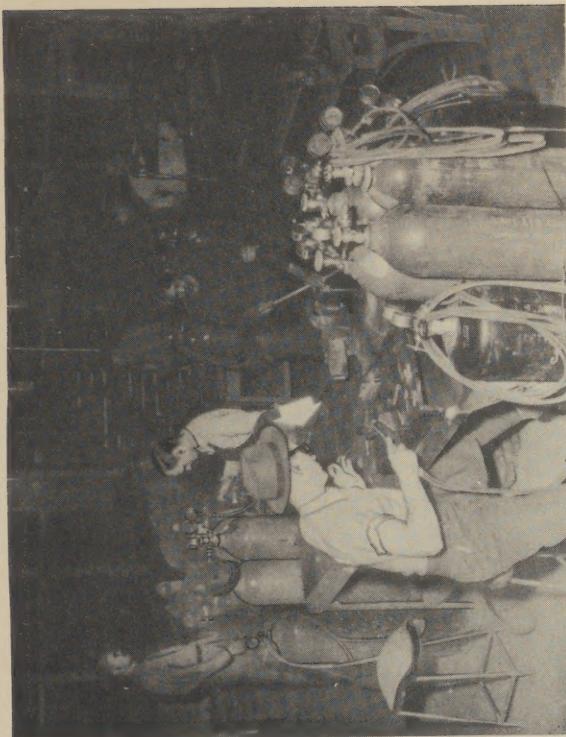
SUGGESTED CONTROL MEASURES

1. Protective helmet, shield, gloves, and apron (electric weld).
2. Goggles (gas weld).
3. Isolation of process.
4. General or local exhaust ventilation.
5. Portable or permanent black shield to protect adjacent workers.

HEALTH HAZARDS

Dermatitis may be caused by ultraviolet and infrared radiation, and fluorine.

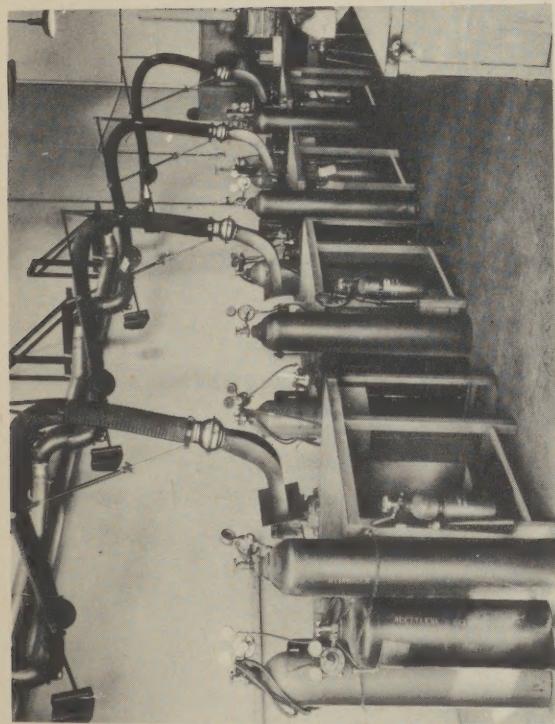
1. **ULTRAVIOLET AND INFRARED RADIATIONS.**—May produce flash burns of the eyes, associated with intense pain and photophobia.
2. **METAL FUMES.**—May produce poisoning from fumes of metals being welded, and metal fume fever.
3. **EXCESSIVE HEAT.**—May produce heat exhaustion with loss of body fluids and chlorides.
4. **FLUORIDES.**—May produce fluorine which is an irritant to upper respiratory tract and skin.
5. **OXIDES OF NITROGEN.**—Produce edema of lungs and, if in sufficient concentration, may cause death.
6. **CARBON MONOXIDE.**—If in sufficient concentration, will produce anoxemia, causing loss of consciousness and death.



Use of goggles in oxyacetylene welding.



Removing fumes by local exhaust ventilation.



The design of the local exhaust ventilating system for this welding operation provides for flexibility of location of the exhaust inlet.



Ventilation turned off. Note the heavy concentration of fumes.

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